A New and Eaſy GUIDE to

The USE of the GLOBES;
AND THE
Rudiments of Geography.

WHEREIN

The Knowledge of the HEAVENS and EARTH is made eaſy to the meaneſt Capacity: Firſt, by giving a ſhort and conciſe Account of the four Quarters of the World, with the Diſtance and Situation of the moſt principal Iſlands and inland Places, and by the Solution of Seventy uſeful Problems in Geography, Aſtronomy, Navigation, &c. Written in familiar Dialogues, in order to render it more eaſy, pleaſant, and diverting to the Learner: With ſome Obſervations on Mr. NEALE's Patent Globes.

To which is annex'd,

THREE uſeful TABLES.

- I. Shews the Latitude and Longitude of the principal Places from the meridian of *London*.
- II. Shewing the Sun's Place, Declination, Time of Riſing and Setting; Length of Days and Nights, and Beginning and Ending of Twilight every Week, according to the New Style.
- III. Shews the Latitude, Longitude, Right Aſcenſion, and Declination of the moſt eminent fixed Stars.

By DANIEL FENNING,

AUTHOR of the YOUNG ALGEBRAIST'S COMPANION, and the BRITISH YOUTH'S INSTRUCTOR, or A New and Eaſy GUIDE to PRACTICAL ARITHMETICK, and the UNIVERSAL SPELLING-BOOK.

Recommended by ſeveral eminent Mathematicians.

The THIRD EDITION,
With Improvements by the Author.

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DEDICATION.

To all public Tutors and Lovers of Mathematical Learning, eſpecially thoſe that I have had the Honour to inſtruct.

THE Uſe of the Globes is now become very common among Gentlemen, to what it was ſome few Years ago; and there are Numbers that cannot bear the Thoughts of going thro' a tedious, though regular Proceſs of *Geometry*, *Trigonometry*, *Algebra*, &c. that find a great Pleaſure in learning upon the Globes, and this I imagine is becauſe the Knowledge of them is ſo eaſily attained to. Nothing is eaſier than practical *Geography*, commonly called *the Uſe of the Globes*; becauſe no other Branch of Learning is previous to it. He that can read well may arrive at the Knowledge of them as ſoon as another that is well acquainted with Figures.

Some of you may think it a Preſumption in me to publiſh a Book upon a Treatiſe after ſo many upon the ſame Subject, and eſpecially as Dr. *Harris*'s is ſo much uſed: But many of you are ſenſible I have been obliged to explain him to you; and you have owned he is not ſo clear in many of the Problems as could be wiſhed. Beſides, his is a general Treatiſe of the Rudiments of Aſtronomy, mixt with the Uſe of the Globes; but this little Tract treats of Nothing of that Sort, but goes through a Series of Problems (as you will ſee more particularly in the Preface) Step by Step; and as every Problem has an Anſwer, you cannot be at a Loſs to know when you are right.

As I have tryed to render it both eaſy and uſeful in all public Academies, *&c.* as well as to private Gentlemen, you will no Doubt, excuſe ſome few Errors; and in giving it a kind Reception you will do me great Honour, and very much oblige,

London, Aug.
24, 1768.

Your humble Servant,

D. Fenning.

BRITISH MUSEUM 15 JUN 60

PREFACE.

Kind Reader,

I Here preſent you this ſmall Treatiſe of *Geography* and *The Uſe of the Globes.*

The Geographical Part you may very juſtly ſuppoſe I borrowed from different Authors, who no Doubt, were obliged in the ſame Manner to borrow their Accounts from previous Publications: And this Thing is always allowable in Hiſtory, tho' not in every Part of Learning.

Beſides, many Hundreds may happen on one Book, who may never ſee another on that Subject; therefore a Number of Books can never fail of being ſerviceable to the Public; and if every Author makes but an Improvement upon what he takes in Hand, he does well, and the Reader is in ſome Meaſure obliged to him. It may be aſked what Improvements can be made here, ſince there are ſo many large Volumes upon the Subject? I anſwer, that as my Knowledge is not ſufficient, ſo my Intention never could be to give a better Account of Things than they have done. But the Point in Hand is, whether I have not drawn the Work into a narrow Compaſs, ſo as not to burthen the Memory, and yet, at the ſame Time, to give a pleaſant and ſatisfactory Account of what is both neceſſary and uſeful to every common Reader. If I have in any Reſpect done this, I have done as much in the Geographical Part as I intended, and more; for my Deſign at firſt was only to treat upon the Deſcription and Uſe of the Globes; therefore I hope, if any Errors have crept in on the firſt Part, they will be pardoned. For

Some Authors, obſerve, differ from others. Thus *Gordon* ſays, that the Metropolis of *Maryland* is *Baltimore*, in Honour of Lord *Baltimore*; but *Taylor* and *Dapier* ſay *Annapolis-Royal* is the Capital.

—Which of theſe are right I cannot determine; only this I ſay, that *Gordon* ſeems to be right according to Hiſtory, and *Taylor* according to Cuſtom; becauſe *Annapolis-Royal* is the chief Place of Traffic and Buſineſs. But I leave this to better Judges, and will give ſome Account of the Work in general.

Dialogue I. II. III. and IV. Contains a ſhort and eaſy Account of the Situation of the moſt principal Places in the known World, with their Diſtance from *London* in an Arch of a great Circle.

Dial. V. and VI. Contains a general Deſcription of the Globes, with the Nature and Property of the Sphere, and the different Situation of the Inhabitants of the World, in reſpect of each other.

Dial. VII. An Explanation of the moſt uſeful Terms in *Geography*; to which is annexed, three uſeful Tables.

1. Shews the Latitude and Longitude of the moſt principal Places from the Meridian of *London.*

2. Shews the Sun's Place, Declination, Time of riſing and ſetting, *&c. &c.*

3. Shews the Latitude and Longitude, right Aſcenſion, *&c.* of the moſt eminent fixed Stars, taken from *Senex's* Globes.

Dial. VIII. Contains 70 Problems performed by the Globes, many of which are very uſeful in ſhewing the Nature of Spherical Triangles, and are applied to *Navigation*, *Dialling*, &c. and I have not only given you the Rule to work them by, but have given you the Anſwers to the Problems, that you may know when you are right. If indeed your Anſwer be not exact with mine in Reſpect to *Minutes*, never mind that; for I have taken the neareſt Quarter of a Degree for the Anſwers in general: Thus, if it were 12 Minutes, I call it 15 or ¼ of a Degree. I have done the ſame when it is 20 Minutes, but if it be near ½ a Degree on the Quadrant, I call it 30 Minutes; and this I have done on Purpoſe to avoid puzzling the Learner, becauſe we cannot gueſs to a Minute or two on the Quadrant, and Globes will often differ for Want of good Appendants.

As for the Diſtance of Places from *London*, I have taken it from no Book or Perſon; and tho' I agree with *Echard*, and ſeveral others, in Reſpect of Degrees, yet I differ from them in my Anſwer in Miles, moſt of them allowing but 60 Miles or Minutes to a Degree, and I have counted 69 ½ to a Degree. If you cannot multiply the Degrees by 69 ½, then multiply by 70, and take ½ the Number of Degrees out of that Product, it is the ſame as multiplying by 69 ½.

In fine, I have endeavoured to render it as uſeful as I could, and I am ſenſible *Any-body* may (of himſelf) learn the Uſe of the Globes by it, if he will but take the Trouble to learn the Signs and Terms previous to ſuch an Undertaking.

Arts and Sciences are not learned by ſupine Reading only; there muſt be ſome Practice, or elſe the bare reading will never make a compleat Artiſt; and if ſo, how can it be expected that he ſhould underſtand that never reads at all.

It is not ſaying, I have got *Chambers's* Dictionary of Arts and Sciences, or a Thouſand Volumes in your Library, that will convince the World you underſtand them; for, without a little Pains, you will never be a Jot the wiſer in the practical Part of the Mathematical Studies.

But as for the Uſe of the Globes, it is ſo eaſy and ſo natural that moſt Perſons eſteem it as a Pleaſure, rather than a Study; and as the Knowledge of them is very uſeful, as well as entertaining, I would recommend it to young Gentlemen in general, as they may learn the Uſe of them without Pains, and, in ſhort, without Loſs of Time.

I am, Kind Reader,

Your humble Servant,

and Well-wiſher,

London, Aug. 24, 1768.

D. Fenning.

BRITISH MUSEUM 15 JUN 60

TO THE

PUBLICK.

WE whoſe names are hereunto ſubſcribed, having peruſed this Epitome of Geography, do allow it to be very well adapted to the capacity of all ſuch as would have a true and ſpeedy notion of the ſituation of the moſt principal places in the known world. And for a variety of problems, ſo eaſily ſet forth, and ſo plainly demonſtrated, we beg leave to recommend to every learner, as the moſt uſeful book extant. Witneſs our hands,

George Coles, *Surveyor.*
Henry Deacon, *Accomptant.*
Edward Griffiths, *Surveyor and Accomptant.*
Antony Gilbert, *Surveyor.*
Abraham De Lire, *Philo Math.*
John Quant, *Teacher of the Mathematics.*
William Simſon, *Philo. Math.*
John Smythe, *Accomptant.*
James Thurſton, *Ditto.*

To the RECOMMENDERS.

GENTLEMEN,

I Return you hearty thanks for your kind favours in honouring me with your names to this ſmall Treaiſe. Your aſſiſtance in diſcovering any errors that I have omitted correcting will ſtill further oblige,

GENTLEMEN,

ug. 24, 1768. *Your very humble Servant,*

Daniel Fenning.

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15 JUN 60

A
NEW and EASY
GUIDE, &c.

DIALOGUE I.

Between PHILO, *a Tutor, and* TYRO, *a Pupil, concerning* GEOGRAPHY *in general.*

SECT. I.

Tyro. YOU have already been ſo kind, dear *Philo*, as to inſtruct me in the knowledge of common arithmetic, and the rudiments of algebra, and you promiſed to inſtruct me alſo in the uſe of the globes: if then it be agreeable to you, I ſhould be very glad to learn forthwith.

Philo. With all my heart; it pleaſes me much to ſee you delight in any thing of this ſort, rather than ſpend your time in idleneſs, which is the parent of miſchief; I am therefore as ready to teach you as you are willing to be taught: but I think it would not be amiſs to give you firſt a little notion of geography, as it will not only the better qualify you for this undertaking, but will be a great help to you for the more ready underſtanding what you read.

Tyro. I thank you, Sir; for indeed I have very little notion, and ſcarce know what you mean by geography?

Philo. Geography is a ſcience which explains and teaches the properties of the earth, both in reſpect to land and water.

Tyro. Into how many parts is the earth divided?

Philo. Into 4 parts, or quarters; *viz.* 1. *Europe.* 2. *Aſia.* 3. *Africa*, and 4. *America.*

Tyro. What are the other nominal parts of the earth; or how is it yet further divided in relation to land and water?

Philo.

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Philo. Into 10 different names; 5 belonging to the diviſion of land; *viz.* 1. A continent. 2. An iſland. 3. A promontory or cape. 4. A peninſula. And 5. An iſthmus. And theſe anſwer to the next 5 belonging to the water; *viz.* 1. An ocean. 2. A lake. 3. A bay. 4. A gulph. And 5. A ſtreight. Theſe anſwer to each other (as was ſaid before) as more plainly appears by the following deſcription.

LAND.	WATER.
1. A continent is a large tract, or vaſt extent of main land, not ſeparated by any ocean. Thus *Europe*, *Aſia*, *Africa*, &c. are continents.	1 An ocean (or ſea) is a large extent or collection of waters, free from land; ſuch as the *Atlantic* or *Weſtern Ocean*, the *Indian Ocean*, &c.
2. An iſland is a tract of land ſurrounded with water, as *Great-Britain*, *Ireland*, *Madagaſcar*, &c.	2. A lake is a tract of water ſurrounded by land: as the Lake of *Geneva*, the *Dead Sea*, the *Caſpian Sea*, &c.
3. A promontory, or Cape, is a portion or part of land running far into the ſea; as *Cape Verde*, *Cape of Good Hope*, &c.	3. A bay is a portion or part of the ſea running far up the main land; as the *Bay of Biſcay*, *Bay of Siam*, &c.
4. A peninſula is a part or portion of the earth almoſt	4. A gulph (or inland ſea) is a part of the ocean almoſt ſurrounded

LAND.	WATER.
moſt ſurrounded with water, ſave only a narrow part or neck of land which ties or unites it to a continent: as *Africa* itſelf, *Jutland*, &c, &c.	ſurrounded with land, ſave ſome ſtreight or narrow gut of water, by which it has communication with the ocean; as the *Gulph of Arabia*, the *Mediterranean Sea*, &c.
5. An iſthmus is a narrow part of land, by which a peninſula is joined to a continent, or main land; as the iſthmus of *Panama*, which joins *North* and *South America* together; the iſthmus of *Corinth*, &c. &c.	5. A ſtreight is a narrow paſſage or part of the ſea, which joins one ſea to another; as the *Streights of Gibraltar*, which joins the *Mediterranean Sea* to the *Atlantick Ocean*; the *Streights of Babelmandel*, &c. &c.

SECT. II.

A further deſcription of the four quarters of the world; and,

I. Of EUROPE.

Tyro. WHAT are the principal kingdoms or parts into which *Europe* is divided?

Philo. They are 9 in number; *viz.* 1. *Scandinavia* (which contains *Sweden* or *Swedeland*, *Denmark*, and *Norway.*) 2. *Moſcovia*, or *Ruſſia*. 3. *France*. 4. *Germany*.

many. 5. *Poland*. 6. *Spain*. 7. *Italy*. 8. *Portugal*. *And* 9. *Turkey*.

Tyro. Pray give me ſome ſhort account of theſe in reſpect of their ſituation on the globe, and to each other?

Philo. That I will, my dear pupil; but it muſt be but a ſhort account indeed; juſt to give you a little idea, and qualify you the better for reading and converſation.

I. Of SCANDINAVIA.

Tyro. What do you mean by *Scandinavia*, and how, or whereabouts is it ſituate?

Philo. *Scandinavia* is a large continent, ſituate between 54 and 72 degrees of N. latitude; under which name is comprehended the kingdoms of *Sweden*, *Denmark*, and *Norway*, as was ſaid before.

1. SWEDEN.

Tyro. How is *Sweden* ſituate?

Philo. *Sweden* is bounded on the N. and E. by *Norway*, on the E. by *Moſcovia*, and on the S. by the *Sound*, and part of the *Baltick*. Its metropolis or chief town is

Stockholm,

Stockholm, whoſe diſtance from *London* is about 12¾ degrees; *viz.* 886 miles N. E. The longeſt day in the moſt northern parts of this country is about two months, and the ſhorteſt in the moſt ſouthern parts about 6½ hours.

2. DENMARK.

Tyro. How is *Denmark* ſituate?

Philo. *Denmark* is bounded on the N. by the *Sound*, on the E. by the *Baltick*, on the S. by part of *Germany*, and on the W. by the *German Ocean*. Its metropolis is *Copenhagen*, whoſe diſtance from *London* is 610 miles N. E. The length of the longeſt day in the moſt northern parts of this country is about 17½ hours; and the ſhorteſt in the moſt ſouthern about 8¼ hours long.

3. NORWAY.

Tyro. How is *Norway* ſituate?

Philo. *Norway* is bounded on the N. W. and S. by part of the *Main Ocean*, and on the E. by *Sweden* and the *Gulph of Bothni*.

Its metropolis is *Bergen*, whoſe diſtance from *London* is about 9¼ degrees; *viz.* 642 miles N. by E. The length of the longeſt day in the moſt northern parts is above 2 months, and the ſhorteſt in the moſt ſouthern about 6½ hours.

II. Of MOSCOVIA *or* RUSSIA.

Tyro. How is *Moſcovia* ſituate?

Philo. Moſcovia is bounded on the N. by the great *Northern Ocean*, on the E. by *Tartary*, on the W. by *Sweden*, and on the S. by the *Caſpian Sea*, and part of *Little Tartary* and *Georgia*. Its length is computed to be about 1250 miles, and breadth about 1100 miles. Its chief province is *Moſcovy*, and its metropolis *Moſcow*, whoſe diſtance from *London* is about 23 degrees; *viz.* is nearly 1600 miles N. E. and about 800 E. of *Cracow*. The longeſt day in the moſt northern part of this country is about 2 months, and the ſhorteſt in the moſt ſouthern is about 9½ hours.

III. Of FRANCE.

Tyro. How is *France* ſituate?

Philo. France (called *Gallia*, or the place of the antient *Gauls*) is bounded on the N. by the *Engliſh* channel, on the E. by *Germany*, on the S. by part of *Spain* and the *Mediterranean Sea*, and on the W. by the *Bay of Biſcay*. Its length is computed to be 550 miles, and the breadth 380. Its metropolis is *Paris*, whoſe diſtance from *London* is about 3 degrees S. S. E. *viz.* 210 miles. The length of the longeſt day in the moſt northern part of this kingdom is about 16¼ hours, and the ſhorteſt in the moſt ſouthern part 9¼ hours.

IV. Of GERMANY.

Tyro. How is *Germany* divided?

Philo. Germany is in length about 550 miles, and breadth about 510. It is divided into three parts; *viz. Holland*, *Flanders*, and *Upper Germany*.

1. HOLLAND.

Tyro. How is *Holland* ſituate?

Philo. *Holland* is bounded on the N. by part of the *German Ocean*, on the E. by *Upper Germany*, on the S. by *Flanders*, on the W. and part of the N. by the *German Ocean.* Its metropolis in the N. part is *Amſterdam*, whoſe diſtance from *London* is about 210 miles E. and *Rotterdam* on the S. which is about 190 S. E. of *London.*

2. FLANDERS, *or* SPANISH NETHERLANDS.

Tyro. How is *Flanders* ſituate?

Philo. *Flanders* is bounded on the N. by *Holland*, on the E. by *Upper Germany*, on the S. by *France*, and on the W. by the *German Ocean.* It has many fair and rich provinces, the metropolis of which is *Antwerp*, whoſe diſtance from *London* is about 185 miles E.

3. UPPER GERMANY.

Tyro. What do you mean by *Upper Germany*, and how it it ſituate;

Philo. *Upper Germany* is part of *Germany* itſelf, and part of *Gallia* and *Old Italy.* It is bounded on the N. by *Denmark* and part of the *Baltick*, on the E. by *Poland*, on the S. by *Italy*, and on the W. by *France.* Its metropolis is *Cologne*, whoſe diſtance from *London* is about 340 miles E.

V. Of POLAND.

Tyro. How is *Poland* ſituate?

Philo. *Poland* is bounded on the N. by part of *Moſcovia* and part of the *Baltick*, on the E. by *Little Tartary* and part of *Moſcovia*, on the S. by *Hungary*, *Tranſilvania* and *Moldavia* in *Germany*, and on the W. by *Upper Germany.* Its length is about 600 miles, and breadth about 590. Its metropolis is *Cracow*, whoſe diſtance from *London* is 13½ degrees; *viz.* about 940 miles E. The longeſt day in the moſt northern part of this country is about 17½ hours, and the ſhorteſt in the moſt ſouthern about 8¼ hours.

Tyro. Are there any other remarkable places belonging to *Poland*?

Philo. Yes, *Pruſſia*, whoſe chief town is *Dantzick*; and *Little Ruſſia*, whoſe chief town is *Lemburg*.

VI. Of SPAIN.

Tyro. How is *Spain* ſituate?

Philo. Spain, formerly called *Iberia Heſperia*, is bounded on the N. by part of *France* and the *Bay of Biſcay*, on the E. by the *Mediterranean*, on the S. by the *Streights of Gibraltar*, and on the W. by *Portugal*. Its metropolis is *Madrid*, whoſe diſtance is better than 11 degrees; *viz.* about 780 miles S. by W. of *London*. The longeſt day in the moſt northern parts of this kingdom is about 15¼ hours, and the ſhorteſt in the moſt ſouthern part is about 9¼ hours.

VII. Of PORTUGAL.

Tyro. How is *Portugal* ſituate?

Philo. Portugal is bounded on the N. by part of the *Bay of Biſcay*, on the E. by *Spain*, and S. and W. by the *Atlantic Ocean*. Its metropolis is *Liſbon*, whoſe diſtance from *London* is better than 14 degrees S. W. by S. *viz.* about 980 miles. The longeſt day in the moſt northern parts of this country is about 15 hours, and the ſhorteſt in the moſt ſouthern about 9¼ hours.

VIII. Of ITALY.

Tyro. How is *Italy* ſituate?

Philo. *Italy* is bounded on the N. by part of *Germany*, and on the N. E. by the *Adriatic Sea*, or *Gulph of Venice*, and on the S. and W. by the *Mediterranean* and part of *France*. Its metropolis is the city of *Rome*, the ſeat of Papacy, and reſidence of the Pope, the pretended ſucceſſor of St. *Peter*, and infallible head of the church in all ſpiritual matters and controverſies, as appears by the articles of their faith. * Its diſtance from *London* is nearly 13 degrees S. E. *viz.* about 903 miles.

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* I confeſs it is not my buſineſs to enter upon any thing foreign to the undertaking; nor did I in the leaſt premeditate upon, or intend it, till I came to this place, in which it may be expected by ſome (and I think it cannot offend any well-wiſher to Proteſtantiſm) that I ſhould give a ſmall account of the tenets, or belief, of the ROMISH church. And as I am ſenſible the emiſſaries of *Rome* are never wanting, by artifice and cunning, to gain many proſelytes to their perſuaſion (and eſpecially from the eſtabliſhed church) I think

Here follows a brief account of the popiſh creed, or articles of faith, commonly called pope *Pius* IVth's creed.

Note. This creed is divided into 24 articles; the firſt 12 of which, being the very ſame as our *Nicene Creed*, I omit, and begin with the 13th article.

Art. 13. *I moſt firmly admit and embrace the apoſtolical and eccleſiaſtical traditions, and all other obſervations and conſtitutions in the church of* Rome.

Art. 14. *I do admit the holy ſcriptures in the ſame ſenſe that holy mother-church doth, whoſe buſineſs it is to judge of the true ſenſe and interpretation of them; and I will interpret and receive them according to the unanimous conſent of the fathers.*

☞ Art. 15. *I do profeſs and believe that there are ſeven ſacraments of the* New Teſtament, *truly and properly ſo called, inſtituted*

I think the digreſſion will not be taken amiſs: for it may happen, that this ſmall tract may fall into ſuch hands as have not yet heard of their errors and inconſiſtencies; and if but one out of thoſe many by this means be prevented from falling a ſacrifice to their pernicious principles, it will as much anſwer my deſign as their welfare.

tuted by Jeſus Chriſt *our Lord, and neceſſary for the ſalvation of mankind, tho' not all of them to every one*; viz. *baptiſm, confirmation, the euchariſt, penance, extreme unction, orders, and marriage: and that they do confer grace; and that of theſe, baptiſm, confirmation and orders may not be repealed without ſacrilege: I do alſo receive and admit the received and approved rights of the catholic church, in her ſolemn adminiſtration of the ſaid ſacraments.*

Art. 16. *I do embrace and receive all and every thing that hath been defined and declared by the holy council of* Trent, *concerning original ſin and juſtification.*

☞ N. B. Art. 17. *I do alſo profeſs that in the Maſs there is offered unto God a true, proper, and propitiatory ſacrifice for the quick and the dead; and that in the moſt holy ſacrament of the euchariſt there is truly, really, and ſubſtantially the body and blood, together with the ſoul and divinity of our Lord* Jeſus Chriſt; *and that there is a converſion made of the whole ſubſtance of the bread into the body, and of the whole ſubſtance of wine into the blood; which converſion the catholic church calls tranſubſtantiation.*

This article is not only blaſphemous, but even ridiculous beyond meaſure, ſince every one now knows that matter (*viz.* any ſubſtance) cannot be in two or more places at one and the ſame time: therefore let us charitably conclude, that the more learned ſort of perſons cannot poſſibly believe this article, though they are bound to give their aſſent to it.

Art. 18. *I confeſs under one kind only, whole and entire,* Chriſt *and a true ſacrament* is [*] *taken and received.*

Art. 19. *I do firmly believe that there is a purgatory, and that the ſouls kept priſoners there do receive help by the ſuffrages (or prayers) of the faithful.*

☞ Art. 20. *I do likewiſe believe that the ſaints reigning together with* Chriſt *are to be worſhipped and prayed unto; and they do offer prayers unto God for us; and that their relicks are to be had in veneration.*

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[*] It is worthy your notice to obſerve, the verb *is* in this article is not good grammar; for *Chriſt* and the ſacrament being two diſtinct things, the *verb* ſhould be *are*. But to reconcile this with the foregoing article, they have put the *verb is*, to ſhew that the real body and blood of *Chriſt*, and the euchariſt, are one and the ſame. This is a cunning, but a wicked and ignorant inconſiſtency.

Art. 21. *I do moſt firmly aſſert that the images of* Chriſt, *of the Bleſſed Virgin, the Mother of God, and of the other ſaints, ought to be had and retained, and that due honour and veneration ought to be given them.*

Art. 22. *I do affirm that the power of indulgencies was left by* Chriſt *in the church, and that the uſe of them is very beneficial to chriſtian people.*

Art. 23. *I do acknowledge the holy catholic* Roman Church *to be the mother and miſtreſs of all churches; and I do promiſe and ſwear true obedience to the biſhop of* Rome, *the ſucceſſor of St.* Peter, *the prince of the apoſtles, and vicar of* Jeſus Chriſt.

Art. 24. *I do undoubtedly receive and profeſs all other things which have been delivered, defined, and declared by the ſacred canons and occumenical councils, and eſpecially by the holy ſynod of* Trent; *and all other things contrary thereunto, and all hereſies condemned, rejected, and anathematized by the church, I do alſo condemn, reject, and anathematize.*

Conſider, *Tyro*, whether theſe impoſitions are conſiſtent with chriſtian liberty.

IX. *Of* TURKEY *in* Europe.

Tyro. How is *Turkey* ſituate?

Philo. *Turkey* is bounded on the N. part by *Poland*, on the E. by the *Black Sea*, and part of *Turkey* in *Aſia*, on the S. by part of the *Ionian Sea*, and on the W. by the *Gulf of Venice*, and part of *Germany*. It lies between 36 and 49 degrees N. latitude. Its metropolis is *Conſtantinople*, whoſe diſtance from *London* is 23 ¼ degrees; *viz.* about 1650 miles E. by S.

The length of this country is about 660 miles, and its breadth about the ſame. The longeſt day in the moſt northern part is about 16 hours, and the ſhorteſt in the moſt ſouthern about 9 ¼ hours.

The diviſion of TURKEY.

Tyro. Is not *Turkey* divided into different parts or claſſes?

Philo. Yes, into many, but chiefly into four; viz. 1. *Hungary.* 2. *Greece.* 3. *Little Tartary*, called by ſome *Crim Tartary*, from a large town. 4. The *Danubian* provinces.

1. HUNGARY.

Hungary, tho' now chiefly under the emperor of *Germany*, is notwithſtanding a part of *Turkey*. It is bounded on the

N. by part of *Poland*, on the E. by *Tranſilvania*, on the S. by *Sclavonia*, and on the W. by *Auſtria*. Its chief city is *Buda*, whoſe diſtance from *London* is better than 12½ degrees; viz. about 840 miles S. E.

2. GREECE.

Tyro. How is *Greece* ſituate?

Philo. *Greece* is bounded on the N. by the *Danubian* provinces, on the E. by the *Ægean Sea*, called *Archipelago*, on the S. and W. by the *Mediterranean*. Its chief cities are *Athens* (or *Settines*) and *Adrianople*; the firſt of which is about 420 miles S. W. of *Conſtantinople*, and the other about 146 N. W. of the ſame. *Corinth* is about 54 miles W. of *Athens*, and *Thebes*, or *Stives*, is about 45 N. W. of *Athens*.

3. LITTLE TARTARY.

Tyro. How is *Little Tartary* ſituate?

Philo. *Little Tartary* is bounded on the N. by part of *Moſcovia*, on the E. by *Georgia*, on the S. by the *Black Sea*, and on the W. by *Podolia*.

Its metropolis is *Kaffa*, ſubject to the *Turks*;

Turks; it ſtands near the *Euxine Sea*, about 380 miles N. E. of *Conſtantinople*, and about 500 miles S. of *Moſcow*.

4. *Of the* DANUBIAN *provinces*.

Tyro. What do you mean by the *Danubian* provinces; and how are they ſituate?

Philo. They are ſo called, becauſe they chiefly ſtand upon, or near the *Danube*, which extends itſelf from *Kilia*, near the *Black Sea*, to *Vienna* in *Germany*.

Tyro. How many provinces are there?

Philo. Nine; 1. *Tranſilvania*. 2. *Valachia*. 3. *Moldavia*. 4. *Romania*. 5. *Bulgaria*. 6. *Seriva*. 7. *Boſnea*. 8. *Sclavonia*. 9. *Croatia*.

SECT. III.

Of the EUROPEAN *iſlands*; *and*,

1. *Of* ENGLAND.

Tyro. HOW is *England* ſituate?

Philo. *England* (called alſo *Anglia*, *Britannia*, or *Albion*) is bounded on the N. by *Scotland*, on the E. by the *German Ocean*, on the S. by its own channel,

nel, which parts it from *France*, and on the W. by *St. George*'s, or the *Iriſh Sea*: it lies between 50 and 56 degrees N. latitude: its length is about 320, and breadth about 290 miles: its metropolis is *London*.

This iſland contains 38 counties, beſides *Middleſex* and *Cheſhire*; this laſt being a county palatine, having the privilege of its own particular judges, counſellors, *&c.* It has two univerſities, *Cambridge* and *Oxford*, and 24 biſhopricks.

Tyro. Are theſe all the counties in *England*?

Philo. Yes, excluſive of *Wales*, which has four circuits, twelve counties, and four biſhoprics. The longeſt day in the moſt northern part is about 17 ½ hours, and the ſhorteſt in the moſt ſouthern about 8 hours.

II. *Of* SCOTLAND.

Tyro. How is *Scotland* ſituate?

Philo. *Scotland* (called alſo *Caledonia*) is bounded on the N. and W. by the *Baltick Sea*, on the E. by part of the *German Ocean*, and on the S. by *England*. Its lies between 55 and 59 degrees N. latitude. Its length is about 240, and breadth about 180 miles, and its metropolis is *Edinburgh*, whoſe diſtance from *London* is nearly $4\frac{1}{2}$ degrees; viz about 300 miles almoſt N· The longeſt day in the moſt northern part of this country is about $18\frac{1}{2}$ hours, and the ſhorteſt in the moſt ſouthern $6\frac{1}{2}$ hours.

III. *Of* IRELAND.

Tyro. How is *Ireland* ſituate?

Philo. Ireland (called by ſome *Britannia Parva*, and by others *Hibernia*) is ſurrounded by the *Britiſh Ocean.* It lies between 51 and 55 degrees of N. latitude. The length is about 260, and breadth about 150 miles. Its metropolis is *Dublin*, which is diſtant from *London* nearly $3\frac{1}{2}$ degrees; *viz.* about 240 miles N. W. The length of the longeſt day in the moſt northern part is about $17\frac{1}{2}$ hours, and the length of the ſhorteſt in the moſt ſouthern about $7\frac{3}{4}$ hours.

SECT.

SECT. IV.

I. *Of the leſſer* European *iſlands, and firſt of ſuch as lie near* Great Britain.

1. *Thoſe on the North are,*

1. THE *Orkneys*, or *Orcades*. 2. *Shetland*.

2. *Thoſe on the Eaſt are,*

1. *Holy Land*. 2. *Fern Iſland*. 3. *Cocket Iſland*. 4. *Sheppy Iſland*. And 5. The *Iſle of Thanet*.

3. *Thoſe on the South are,*

1. *Portland Iſland*. 2. The *Iſle of Wight*. 3. *Portſea Iſland*.

4. *Thoſe on the Weſt.*

1. *Lewis Iſland*. 2. *Skye*. 3. *Mul*. 4. *Jura*. 5. *Ila*. 6. *Arran*. 7. *Man*. 8. *Angleſey*. And 9. *Scilly*.

II. *Of other* European *iſlands, more diſtant from* Great Britain.

1. *The* AZORES.

Theſe iſlands lie W. of *England*, and are ſubject to the king of *Portugal*. They are 9 in number; *viz*. 1. *St. Michael*.

2. *St. Maria.* 3. *Tercera.* 4. *Gratioſa.* 5. *St. George's.* 6. *Pico.* 7. *Fyal.* 8. *Flores.* And 9. *Cuervo.*

2. *Thoſe of* SWEDEN.

Theſe are 8 in number; *viz.* 1. *Rugen.* 2. *Bornholm.* 3. *Ocland.* 4. *Gothland.* 5. *Ocſal.* 6. *Dago.* 7. *Aland.* 8. *Ween.*

3. *Thoſe of* DENMARK.

Theſe are 9; *viz.* 1. *Zealand.* 2. *Funen.* 3. *Langland.* 4. *Laland.* 5. *Falſter.* 6. *Mona.* 7. *Pemeren.* 8. *Alſen.* And 9. *Iceland.*

4. *Thoſe of* NORWAY.

Theſe are 4; *viz.* 1. *Carmen.* 2. *Hiſteren.* 3. *Sanien.* 4. *Suroy.*

5. MEDITERRANEAN *iſlands.*

Tyro. How many iſlands go under this name, and how are they ſituate?

Philo. There are 21 nominal iſlands, which are ſituate S. of *Europe*, on, or near, the *Mediterranean Sea*; but the following are moſt noted; *viz.* 1. *Yvica.* 2. *Minorca.* 3. *Majorca*, ſituate W. of *Valencia* in *Spain.* 4. *Corſica.* 5. *Sardigna*, lying S. of *Genoa.* 6. *Malta.* 7. *Sicily*, lying S. W. of *Naples.*

Naples. 8. *Cyprus*. 9. *Candia*. And 10. *Rhodes*, S. of *Antolia* and *Archipelago*.

The other ſmall iſlands, as I have obſerved, are of little or no ſignification. Thus much for *Europe*.

Tyro. I heartily thank you, Sir; and now pray give me a little idea of the other part of the world?

Philo. I will, but it muſt be but a ſhort hint indeed; though I am willing you ſhould have as much inſtruction as this ſmall tract will allow of. Proceed we then to

DIALOGUE II.

SECT. I.

Of ASIA.

Tyro. IN what part of the globe is *Aſia* ſituate?

Philo. *Aſia*, though called the ſecond, yet is the principal quarter of the globe, lying upon the E. part thereof, and extends itſelf from 10 degrees S. latitude, to 76 N. latitude, and is divided into 5 principal parts; *viz*. 1. *Tartary*. 2. *China*. 3. *India*. 4. *Perſia*. And 5. *Turkey*.

1. *Of* Tartary.

Tyro. How is *Tartary* ſituate?

Philo. Tartary is bounded on the N. by the *Tartarian Ocean*, or *Frozen Sea*, on the E. by the ſame, and the *Main Ocean*, on the S. by *China*, *India*, and *Perſia*, on the W. by *Muſcovia* or *Ruſſia*. It lies between 35 and 76 degrees N. latitude, and under the 7, 8, 9, 10, 11, 12, and 13, N. climates; is about 3000 miles long, and 2250 broad, and its chief city is *Cambalie*. The longeſt day in the moſt northern part is about 2 months, and the ſhorteſt in the moſt ſouthern about 9 ¾ hours. It is ſubject to the *Great Cham*'s deſpotic government.

2. *Of* China.

Tyro. How is *China* ſituate?

Philo. China is bounded on the N. by part of *Tartary*, on the E. by the *Chineſian Ocean*, on the S. by part of the *Indian Ocean*, on the W. it has *India* without the *Ganges*. It lies between the 4th, 5th, and 6th N. climates, is about 1400 miles long, and 1260 broad, and its chief city is *Pekin*, whoſe diſtance from *London* is 70 ½ degrees; *viz.* about 4900 miles E. and from *Pekin* to *Nankin* about 690 miles S. E. in the former of which is a bell 11 feet diameter, and 12 feet high, weighing above 53 ½ ton. The longeſt day in the moſt northern part is about 14 ¾ hours, and the length of the ſhorteſt in the moſt ſouthern is about 10 ¾. It is under the government of the *Great Cham.*

3. *Of* INDIA.

Tyro. How is *India* ſituate?

Philo. *India* is bounded on the N. by part of *Tartary*, on the E. by *China*, on the S. by the gulf and bay of *Bengal*, and on the W. by *Perſia.* It lies between 9 degrees of S. and 34 of N. latitude. Its length is computed 1680, and breadth much the ſame, and lies under the 3d, 4th, *&c.* N. climates. It is divided into 3 grand parts; *viz.* 1. The *Great Mogul*'s empire, containing *Delli*, *Agra*, (his imperial ſeat) *Cambaia*, and *Bengal.* 2. *India* within the *Ganges*, whoſe chief kingdoms are *Decan*, *Golcond*, *Biſnagar*, and *Malabar.* 3. *India* without the *Ganges*, whoſe chief kingdoms are *Pegu*, *Tonquin*, *Cochinchina*, and *Siam*; this laſt contains *Martiban Siam*, and *Malucca*, ſubject to the king of *Pegu.* Length of days and nights much the ſame as in *China.*

4. *Of* PERSIA.

Tyro. How is *Perſia* ſituate?

Philo. Perſia is bounded on the N. by the *Caſpian Sea*, on the E. by *India*, on the S. by the *Perſian Gulf* and *Indian Ocean*, and on the W. by *Aſiatic Turkey*. It lies between 25 and 45 degrees of N. latitude, and under the 3d and 4th N. climates; therefore muſt of courſe be exceeding hot for many months in the year. Its length is computed about 1450, breadth 1250. It is divided into 3 parts, N. middle, and S. It is governed by the deſpotic power of the *Great Sophy*. They are chiefly *Mahometans*. The longeſt day in the moſt northern parts is about 14 ¾ hours, and the ſhorteſt in the moſt ſouthern about 13 ¼ hours.

5. *Of* TURKEY *in* ASIA.

Tyro. How is *Turkey* ſituate?

Philo. Turkey, ſituate in *Aſia Minor*, is bounded on the N. by the *Black Sea*, on the E. by *Perſia*, on the S. by part of *Africa*, and part of the *Indian Ocean*, on the W. by the *Red Sea*. It lies between 12 and 46 degrees of N. latitude; is computed about 2100 miles long, and 1750 broad. It contains 6 great parts; viz. 1. *Natolia*, whoſe chief city or town is *Burſa.* 2. *Arabia,* whoſe metropolis is *Midina.* 3. *Syria,* whoſe capital is *Aleppo.* 4. *Diarbeck,* whoſe chief city is *Bagdat.* 5. *Turcomania,* whoſe capital is *Arzerum.* And 6. *Georgia,* whoſe metropolis is *Teflis.* This vaſt country is inhabited by *Chriſtians, Mahometans, Jews,* &c. but is chiefly under the *Ottoman Yoke.*

SECT. II.

Of the Aſiatic *iſlands.*

Tyro. HOW many iſlands are here, and how are they ſituate?

Philo. There are a great number, but they are chiefly reduced to theſe ſix, whoſe ſituation is as follows; 1. *Japan iſlands,* E. of *China.* 2. The *Philippine iſlands,* S. W. of *Japan.* 3. The *Moluccas,* S. of the *Philippine.* 4. The *Sund,* W. of the *Moluccas.* And 5. *Ceyton,* W. of the *Sund,* whoſe capital is *Candea,* or *Candy.* And thus much for *Aſia.*

DIALOGUE III.

SECT. I.

Of AFRICA.

Tyro. HOW is *Africa* ſituate?

Philo. Africa, the 3d quarter of the world, and ſituate W. on the globe, is almoſt ſurrounded with the *Atlantic, Ethiopian,* and *Indian Oceans,* and is extended from 35 degrees of S. latitude, to about 35 N. It is principally divided into 8 parts; *viz. Egypt, Barbary, Bildulgerid, Zaara,* called the *Deſart, Negro-Land, Guinea, Nubia,* and *Ethiopia,* beſides iſlands.

1. *Of* EGYPT.

Tyro. How is *Egypt* ſituate and divided?

Philo. Egypt is bounded on the N. by part of the *Mediterranean Sea,* on the E. by the Iſthmus of *Fuez* and the *Red Sea,* on the S. by *Nubia,* on the W. by *Barbary* and the *Deſart.* It was formerly called *Miſraim.* It is divided into *North Erife,* or *Lower Egypt,* whoſe metropolis is *Sabider, Upper Egypt,* whoſe capital is *Sabid,* and the *Red Sea* and its coaſts, whoſe capital is *Coſſir.*

It lies between 21 and 31 N. latitude, and under the 4th and 5th N. climate, is about 650 miles long, and 300 broad. It is governed by the *Turkiſh* emperor, by a *Baſſa*, whoſe dwelling is *Grand Cairo*.

2. *Of* BARBARY.

Tyro. How is *Barbary* ſituate?

Philo. *Barbary* is bounded on the N. by part of the *Mediterranean*, on the E. by *Egypt*, on the S. by *Bildulgerid*, and on the W. by part of the *Atlantic Ocean*. Is extended from 29 to 37 degrees of N. latitude, and lies under the 4th and 5th N. climate. Its length is 2300, and breadth 380 miles.

Barbary is divided into 7 different parts, or kingdoms; *viz*. *Morocco*, *Fez*, *Telenſin*, *Algiers*, *Tunis*, *Tripoli*, and *Barca*, whoſe chief towns are of the ſame name.

It is chiefly under the government of the *Grand Turk*, and emperor of *Morocco*, who is called alſo emperor of *Africa*, king of *Morocco*, *Fez*, *Sus*, and *Taſſale*; and lord of *Gago*, *Dara*, and *Guinea*, and *Great Zeriff* of *Mahomet*, and conſequently, their religion is *Mahometaniſm*. The longeſt day is 14 ¼ hours, and the ſhorteſt 10 ½ hours, as in *Egypt*.

3. Of BILDULGERID.

Tyro. How is *Bildulgerid* ſituate?

Philo. *Bildulgerid* is ſituate on the N. by *Barbary*, on the E. by *Egypt*, on the S. by *Zaara*, on the W. by part of the *Atlantic Ocean*. It lies between 29 and 31 degrees of N. latitude, and under the 3d and 4th N. climate. Its length is about 2050, and breadth 300 miles. The length of days is from 14 hours, to 10 ½ hours. It is governed by many little kings; but all ſubject to the *Great Turk*, or emperor of *Morocco*.

4. Of ZAARA, or the DESART.

Tyro. How is this *Deſart* ſituate?

Philo. *Zaara* is bounded on the N. by *Bildulgerid*, on the E. by *Egypt* and *Nubia*, on the S. by *Negro-land*, and on the W. by the *Atlantic Ocean*.

It is divided into 7 parts; viz. *Borno*, *Gago*, *Bardoa*, *Lempta*, *Targa*, *Zuenziga*, and *Zanhaga*, whoſe capital is *Targaſſa*, the others have the ſame names as their

Provinces. It lies under 15 and 26 degrees of N. latitude, and under the 3d and 4th climate; is in length 2340, and breadth about 330. The days are 13 ¼ long, to 10 ¾ hours. Their government is by ſeveral lords and kings called *Xeques*, and they are chiefly *Mahometans.*

5. *Of* NEGROE-LAND.

Tyro. How is the land of *Negroes* ſituate?

Philo. Negroe-Land, bounded on the N. by *Zaara*, on the E. by *Nubia*, on the S. by *Guinea*, on the W. by part of the *Atlantic Ocean.* It lies between 8 and 22 degrees of N. latitude, and under the 2d and 3d N. climate. It is computed to be about 2280 miles long, and 620 broad. It is divided into 13 provinces; *viz.* Genhoa, Gelata, Tombut, Agades, Cano, Caſſena, Guangara, Melli, Mandinga, Gago, Guber, Zegzeg, and Zanfara, whoſe capitals are of the ſame name. The days are very little different in length from thoſe in Zaara. It is governed by ſeveral kings, but all, or moſt, are ſubject to the king of *Tombut*. Groſs idolatry and *Mahometaniſm* prevail here.

6. Of GUINEA.

Tyro. How is this country ſituate?

Philo. *Guinea* is bounded on the N. by *Negro-Land*, on the E. by *Ethiopia Exterior*, on the S. by the *Ethiopian Ocean*, and on the W. by the *Atlantic Ocean*. It is divided into 4 parts; 1. The coaſt of *Maleguette*, whoſe capital is *Timan*. 2. The *Ivory Coaſt* weſtward, whoſe metropolis is *Toba*. 3. The *Golden Coaſt* eaſtward, whoſe capital is *St. George de Mina*. And 4. The kingdoms of *Benin*, metropolis *Arda*. *Guinea* lies between 5 and 13 degrees of N. latitude. Its length is 1320, and breadth about 400 miles. It is ſubject to the emperor of *Guinea*, and Paganiſm is here obſerved to equal heighth and ridiculous ſuperſtition. Their days from 12 ¾ hours, to 11 ¾ hours.

7. Of

7. *Of* NUBIA.

Tyro. How is *Nubia* ſituate?

Philo. *Nubia* is bounded on the N. by *Egypt*, on the E. by *Ethiopia Exterior*, on the S. by *Ethiopia Interior*, on the W. by part of *Zaara* and *Negro-Land*. It lies between 14 and 22 degrees of N. latitude, and under the ſecond and third N. climate. Its length is about 840, and breadth about 570. It is divided by the river *Nubia* into N. and S. The capital of *North Nubia* is *Samna*, and of *South Nubia*, a town, or city of the ſame name.

It is governed by its own independent powerful prince, who is reported to be very humane. Their traffic is chiefly at *Grand Cairo*. The length of the days are much the ſame as in *Zaara*.

8. *Of* ETHIOPIA INTERIOR.

Tyro. How is this country ſituate?

Philo. *Ethiopia Interior*, called alſo the land of the *Abiſſians*, is bounded on the N. by

N. by *Nubia*, and on the E. S. and part of the W. by *Ethiopia Exterior*. It lies under the 1ſt, 2d, and 3d N. and S. climates; and the length is computed 3600 miles, and breadth about 2200. *Ethiopia Interior* is divided into 8 provinces; viz. 1. *Barnagaſſo*. 2. *Tigremahon*. 3. *Dobaſſat*. 4. *Fatigar*. 5. *Angote*. 6. *Amara*. 7. *Beleguanze*. And 8. *Begramedri*. This is governed by its own independent *prince*, *lord*, or *ruler*, called *Naggaſi*, whoſe government is deſpotical. He ſtiles himſelf the beloved of God; (ſays he ſprung from the ſtock of *Judah*) the ſon of the column of *Sion*, the ſon of the ſeed of *Jacob*, the ſon of the hand of *Mary*, the ſon of *Nahu* after the fleſh, and of St. *Peter* and *Paul* after the ſpirit, *&c.* *&c.* The longeſt day in the moſt northern parts of this country is about 13 ½ hours, and the ſhorteſt in the moſt ſouthern 10 ½ hours.

EXTERIOR.

Ethiopia Exterior is bounded on the N. by *Abyſſina*, on the E. W. and S. by the *Ethiopic Ocean.* And if to this you take in the land of the *Hottentots*, it extends to near 35 degrees S. latitude. It comprehends the kingdoms of *Biafara*, *Loango*, *Congo*, and *Angola*; the empires of *Monoemungi* and *Monopotapa*; and the coaſts of *Cafres*, *Zanguebar*, *Ajan*, and *Abex.* It is governed by various princes, and the people are chiefly groſs Idolaters and Mahometans. As for the *Hottentots*, they ſhew no ſign of any devotion, only very ſuperſtitious.

The days much as in *Ethiopia Interior.*

SECT. II.

Of the AFRICAN *Iſlands.*

Tyro. WHAT are the principal iſlands in *Africa?*

Philo. There are many ſmall iſlands; but the moſt noted are comprehended under 4 names; *viz.* 1. The iſland of

Madagaſcar. 2. *Cape Verde Iſlands.* 3. The *Canary*. And 4. *The Madeira Iſlands.*

1. MADAGASCAR.

This is a large iſland, lying S. E. of *Ethiopia*, and extends from 11 to about 25 of S. latitude; is about 1000 miles long, and 400 broad. It is called by the *Portugueze St. Laurence*, becauſe they firſt diſcovered it on that day. The inhabitants (except in the eaſtern part) are chiefly *Pagans* and *Mahometans*; and are ſo governed by their prieſts (called *Ombiaſſes)* that they are under uncommon ſuperſtitions. Thus, if a child be born upon ſuch a day, they ſay it is unlucky, and therefore give it to the wild beaſts; and, if a woman dies in child-bed, they bury the living child with her, becauſe it is better ſo (they ſay) than to live without a mother to take care of it. And thus, by theſe prieſt-cunning and deluſive perſuaſions, their iſland is very thin of inhabitants. It is under no particular governor.

2. *Cape* VERDE *iſlands.*

Theſe lie S. W. of *Barbary*, and N. W. of *Guinea*, between 13 and 17 degrees N. latitude, and are as follows; 1. *St. Anthony.* 2. *St. Vincent.* 3 *St. Zucia.* 4. *St. Nicholas.* 5. *Inſula de Sal.* 6. *Bonaviſta.* 7. *Mago.* 8. *St. Jago.* 9. *Inſula del Fuego.* 10. *Brava.* The chief town is *St. Jago*, ſubject to *Portugal.*

3. The CANARY *iſlands.*

Theſe lie N. of *Cape Verde* iſlands, and under 27 and 29 N. latitude. They are 7 in number; 1. *Lancerota.* 2. *Forte Ventura.* 3. *Canaria.* (Metropolis the ſame.) 4. *Teneriffe*, famous for its peak, and the firſt meridian in the *French* maps. 5. *Gomera.* 6. *Ferro.* And 7. *Palma.* They are ſubject to the king of *Spain.*

4. MADEIRA, or MADEIRAS.

This lies in about 32 degrees N. latitude, and W. of *Morocco.* Its chief town is *Tonzal.* It is ſubject to the *Portugueze.*

Tyro. Are theſe all the iſlands?

Philo. There are ſome of leſs note; *viz.* 1. *Zocotera,* ſubject to the *Arabians.* 2. *Comoro,* N. W. of *Madagaſcar.* 3. *St. Thomas.* 4. *Prince's Iſland.* And 5. *Annobon,* ſubject to the *Portugueze,* lying W. of *Ethiopia.* 6. *St. Helena,* ſubject to the *Engliſh,* lying S. W. of *St. Thomas's.* And 7. *The Iſle of Aſcenſion,* N. E. of *St. Helena.* Thus much for *Africa.*

Tyro. I return you thanks, Sir,

Philo. Now, *Tyro,* for the laſt quarter of the world; *viz. America.*

DIALOGUE IV.

SECT I.

Of AMERICA.

Philo. WHAT is *America* called, and how is it ſituate?

Tyro. *America*, called the 4th, or laſt quarter of the world, and weſtward on the globe.

It is divided into 2 principal parts, one called *North*, and the other *South America*.

I. Of NORTH AMERICA.

Tyro. Why is this called *North America*?

Philo. Becauſe it lies on the N. ſide, or northward of the equator.

Tyro. Into how many principal parts is this divided?

Philo. Into 5, as follows; *viz.* 1. *Mexico*, or *New Spain.* 2. *New Mexico*, called *Granada*. 3. *Florida*. 4. *Terra Canadenſis*. And 5. *Terra Arctica.*

1. *Of* MEXICO, *or* NEW SPAIN.

Tyro. How is this country ſituate?

Philo. Mexico, diſcovered in 1518, and conquered by the *Spaniards* in 1521, is bounded on the N. by *Nova Granada*, on the E. by the gulph of *Mexico*, on the W. by *Mare del Zur*, or *Pacific Ocean*, and on the S. by *Terra Firma.* It lies chiefly in the frigid zone, between 8 and 30 degrees of N. latitude, and is extended to about 38 degrees of longitude The greateſt length is computed to be 2530, and breadth about 480.

Tyro. Into how many principal parts is this country divided?

Philo. Into 3, called *Audiences*; *viz.* 1. *Guadalajara*, whoſe metropolis is the ſame. 2. *Mexico*. Metropolis the ſame. And 3. *Guatalama*, metropolis *St. Jago de Guat.*

1. GUADALAJARA.

This contains the provinces of *Cinaola*, *New Biſcay*, *Zazaticas*, *Guadalajara*, *Chiameltan*, and *Zaliſco*.

2. *Mexico* contains the provinces of *Panuco*, *Mexico*, *Mechoachan*, *Los Angelos*, *Anlequera*, *Tabaſco*, and *Jucatan*.

3. *Guatalama* comprehends *Soco*, *Nuſco*, *Guatalama*, *Nicaragua*, *Coſta*, *Rica*, *Veragua*, *Honduras*, *Vara*, *Pax*, and *Chiapa*. The longeſt day in the moſt northern part of this country is about 13 ½ hours, and in the moſt ſouthern about 12½ hours. It is governed by the king of *Spain*, under a vice-roy, who reſides at *Mexico*. There are *Pagans*, *Idolaters*, &c. in ſome parts; but the natives adhere, as in *Spain*, to the moſt ſtrict order of *Papacy*.

2. *Of* NEW MEXICO, *called* NOVA GRANADA.

Tyro. How is this part of *North America* ſituate?

Philo. This country was diſcovered by the *Spaniards*, 1540, and is bounded on the N. by *Terra Arctica*, on the E. by *Florida*, on the S. by *Mexico*, or *New Spain*, and on the W. by *California*. Its bounds are not yet known. The chief town is *Santa Fee*, the reſidence of the *Spaniſh* governor.

3. *Of* FLORIDA.

Tyro. How is this country ſituate?

Philo. *Florida*, diſcovered alſo by the *Spaniards*, 1497, and poſſeſſed by them, 1527, is bounded on the N. by part of *Terra Arctica*, on the E. by *Carolina*, or part of *Terra Canadenſis*, on the S. by part of *Mexico* and the *Gulph*, and on the W. by *Mexico* and *California*. It lies between 25 and 30 degrees of N. latitude, and under the 5th and 6th N. climate, is extended to 23 degrees in longitude, and computed to be about 1000 miles long, and 600 broad, in its greateſt length and breadth.

The natives are groſs idolaters, and the main part is governed by ſeveral diſtinct lords, or rulers: but the places upon, or near the ſea coaſts, are ſubject to the *Spaniards*. The longeſt day in the moſt northern part is about 14¼ hours, and the ſhorteſt in the moſt ſouthern about 9 hours.

Its metropolis is *Coca*.

4. *Of* TERRA CANADENSIS.

Tyro. How is this ſituate, and why ſo called?

Philo. It takes its name from the river *Canada*. It is bounded on the N. by part of *Terra Arctica*, on the E. by the *Atlantic Ocean*, on the S. by part of the ſea and the iſland of *Cuba*, and on the W. by *Florida*, *Canada*, &c. It lies between 30 and 62 degrees of N. latitude, and extends to near 40 degrees of longitude: is about 1800 in length, and 1210 in breadth.

Tyro. But pray, is it not divided into ſome principal parts?

Philo. Yes, into N. and S. The N. comprehends, 1. *Terra Canadenſis Propria*. 2. *Nova Britannica*, or *New Bri-*

tain. 3. *Nova Francia,* or *New France.* Chief town *Quebeck.*

Tyro. What does the S. part contain?

Philo. 1. *Nova Scotia.* 2. *New England.* 3. *New York.* 4. *New Jerſey,* E. and W. 5. *Penſylvania.* 6. *Maryland.* 7. *Virginia.* And 8. *Carolina,* all in the poſſeſſion of, and ſubject to, the crown of *Great Britain.*

The metropolis of theſe towns in order are, 1. *Hallifax* in *Nova Scotia.* 2. *Boſton.* 3. *New York.* 4. *Elizabeth.* 5. *Philadelphia.* 6. *Annapolis Royal.* 7. *James Town.* And 8. *Charles Town.*

N. B. *Theſe lie one after another in order from N. to S.*

1. *Nova-Scotia,* diſcovered 1622.

2. *New England,* in 1497, and poſſeſſed for queen *Elizabeth,* by Sir *Philip Amadas,* 1558.

3. *New York,* by Mr. *Hudſon,* 1608, and ſold to the *Dutch,* who kept it till 1664; at laſt it was given by *Charles* II. to the duke of *York*; it was called before *New Netherland.*

4. *New Jerſey*, was diſcovered in 1497.

5. *Penſylvania*, about the ſame time, was given by *Charles* II. to *William Penn*, Eſq; by letters patent in 1680.

6. *Virginia*, in 1427, but more particularly in 1584, by Sir *Walter Raleigh* (who is ſaid to be the firſt that brought tobacco over) for queen *Elizabeth*. Thus called in honour to her as virgin queen.

7. *Maryland*, was alſo diſcovered by the *Engliſh* under the two *Cabots*, 1497, is bounded on the S. by *Virginia*. It has its name from *Mary*, wife of *Charles* I. who gave it by letters patent under that name to the right honourable *Cæcilius Calvert*, lord *Baltimore*, 1632.

8. *Carolina*, diſcovered about the time with *Virginia*, and in 1660 granted by patent to ſeveral noblemen, by *Charles* II.

5. *Of* TERRA ARCTICA.

Tyro. What do you mean by this name?

Philo. It is called *Arctica*, becauſe *Arctic* is N. therefore it comprehends thoſe countries of *America* ſituate near or towards the N. pole, or polar circles.

Tyro. Which be they?

Philo. There are many of them; but the chief, and moſt noted are, 1. *Greenland.* 2. *Spitſberg.* 3. *Nova Zembla.* 4. *Terra de Jeſſo.* 5. *New Denmark.* And 6. *New North Wales.*

Theſe are known very little of at preſent, but barely their names, therefore cannot be taken any further notice of.

II. Of SOUTH AMERICA.

Tyro. Why is this ſo called?

Philo. Becauſe it lies chiefly on the S. ſide of the equator.

Tyro. Into how many principal parts is it divided?

Philo. Into 8; *viz.* 1. *Terra Firma.* 2. *Peru.* 3. The *Land of the Amazons.* 4. *Braſil.* 5. *Chili.* 6. *Paraguay.* 7. *Terra Magellanica.* And 8. *Terra Antarctica.*

1. *Of* TERRA FIRMA.

Tyro. How is this ſituate?

Philo. *Terra Firma* was diſcovered in 1514, lies under the 1ſt N. climate, and is bounded on the N. by part of *Mexico*, on the E. by part of the *Atlantic*, on the S. by *Peru* and part of *Braſil*, and on the W. by *Mar del Zur*. It is extended to about 27½ degrees longitude, and lies under from 1 to 11½ degrees N. latitude. It is computed to be about 1500 miles long, and 750 miles broad.

Tyro. How is it divided?

Philo. Into E. and W. The E. upon the river *Orinoque*, called 1. *Guian*, whoſe chief town is *Manhoa*. And 2. *Caribana*, whoſe metropolis is *Moreſhego*. The W. comprehends the provinces of

1. *Panama*, called alſo *Terra Firma*; chief town is *Panama*.

2. *Carthagena*, metropolis the ſame.

3. *St. Martha*, metropolis the ſame.

4. *Rio de la Hacha*, metropolis the ſame.

5. *Andaluzia*, metropolis *Comana*.

6. *Paria*, metropolis *Maluregvara.*

7. *Granada*, metropolis *St. Fee de Bagato.*

8. *Papayan*, metropolis *St. Fee de Antiochia.*

It is governed by the king of *Spain*, by a vice-roy reſiding at *Mexico.* The natives of this country, eſpecially in the middle, are groſs idolaters.

2. *Of* PERU.

Tyro. How is this country ſituate?

Philo. Peru, firſt diſcovered by the *Spaniards*, 1525, is bounded on the N. by part of *Terra Firma*, on the E. by *Amazonia*, on the S. by *Chili*, and on the W. by *Mar del Zur.* It lies between 24 degrees of S. and 1 degree of N. latitude, and is extended to 20 degrees of longitude, and under the 1ſt, 2d, and 3d. S. climate.

Tyro. How is it divided?

Philo. Into ſix provinces.

1. *Poſto*, whoſe metropolis is *Poſton.*

2. *Los Quixos*, whoſe metropolis is *Baeſa.*

3. *Pacamores*, whoſe metropolis is *Valladolid.*

4. *Quito*, metropolis *Quito.*

5. *Peru*, metropolis was *Lima.*

6. *Los Carcas*, metropolis *Potoſi.*

The natives in general are very groſs idolaters, worſhipping ſun, moon, ſtars, thunder, lightning, *&c.* But in ſome parts there are chriſtians, *&c.*

It was quite conquered by the *Spaniards* in 1533, and they have the moſt conſiderable part of it under their government.

3. *Of the Land of the* AMAZONS.

Tyro. How is this land ſituate?

Philo. This country, diſcovered by the *Spaniards* in 1541, is bounded on the N. by *Terra Firma*, on the E. by *Braſil*, on the S. by *Paraguay*, and on the W. by *Peru.*

It lies under the 1ſt, 2d, and 3d S. climate. It is under no particular government: the inhabitants in general being a ſavage ſort of people, appearing always in arms. It is ſuppoſed to take its name from thoſe warlike women (called (by ſeveral poets and hiſtorians) *Amazons*, of whom it is reported they cut off one of their breaſts, not only for the better qualifying themſelves to hold their bows, and ſhoot the ſurer, but that they might be the more ſavage and rapacious.

4. *Of* BRASIL.

Tyro. How is *Braſil* ſituate?

Philo. This country, diſcovered by the *Portugueze*, in about 1501, is bounded on the N. by *Terra Firma*, on the E. by the *Atlantic Ocean*, on the S. by *Paraguay* and part of the *Main Ocean*, and on the W. by the land of the *Amazons*.

It lies between 1 and 23 degrees of S. latitude, and under the 1ſt, 2d, 3d, and 4th S. climate.

Its greateſt length is computed about 1600 miles, and its breadth about 1380.

Tyro. Into how many principal parts is it divided?

Philo. There is not any particular account of its provinces, diviſions, *&c.* but the chief towns that are known, or moſt worthy of note, are as follows: 1. *St. Vincent.* 2. *Sanctos.* 3. *Angra Dos Reyes.* 4. *St. Sebaſtian.* 5. *Spiritu Sancto.* 6. *Porto Seguro.* 7. *St. Salvadore.* 8. *Pernambuco.* And 9. *Parayba.*

They are under no particular government nor religion, being chiefly ſunk into all ignorance, idolatry, *&c.*

5. *Of* CHILI.

Tyro. How is this country ſituate?

Philo. *Chili*, diſcovered by the *Spaniards* about 1554, is bounded on the N. by *Peru*, on the E. by *Paraguay*, on the S. by *Terra Magellanica*, and on the W. by the *Pacific Ocean.*

It lies between 25 and 44 degrees of S. latitude, and under the 4th, 5th, and 6th S. climate.

Its length is computed to be about 1100 miles.

Tyro. Into how many parts is *Chili* principally divided?

Philo. Into 3; viz. 1. *Chili Propria.* 2. *Chili Imperial.* And 3, *Chucuito*, whoſe chief towns are *St. Jago*, *Balvida*, and *Mandoſa.*

Though I am not upon hiſtory, *Tyro*, yet it may be ſome ſatisfaction to tell you, there is in ſeveral places in this country, a prodigious large, ravenous and carnivorous bird, called a *Conter*, which (as ſeveral hiſtorians report) will ſeize, and ſoon deſtroy, and eat a ſheep, or ſmall calf; and two of them will attack a cow, or any large tame beaſt.

It is chiefly governed by the vice-roy of *Peru*, under the king of *Spain*.

6. *Of* PARAGUAY.

Tyro. How is *Paraguay* ſituate?

Philo. This country, diſcovered alſo by the *Spaniards* in 1546, is bounded on the N. by the land of the *Amazons* and part of the ocean, on the E. by the *Atlantic Ocean*, on the S. by the *Southern Ocean* and *Terra Magellanica*.

Tyro. Whence has it its name?

Philo. From the river *Paraguay*; but it is called by the *Spaniards* (and currently by others) *Rio de la Plata.*

It lies between 18 and 37 degrees of S. latitude, and under the 2d, 3d, 4th, and 5th S. climate, and extends to about 32 degrees of longitude.

Its length is computed about 1200 miles, and breadth about 1100 miles.

Tyro. Into how many principal parts is it divided?

Philo. The moſt material provinces are 5 in number; viz. 1. *Guayra*, whoſe chief town is *Cividad Real.* 2. *Paragaia Propria*, whoſe chief town is *Villa Rica.* 3. *Chaco*, whoſe chief town is *Conception.* 4. *Tucoman*, whoſe chief town is *St. Jago.* And 5. *Rio de la Plata*, whoſe chief town is *Aſſumption.* It is governed chiefly by a vice-roy.

7. *Of* TERRA MAGELLANICA.

Tyro. How is this country ſituate?

Philo. It is bounded on the N. by part of *Paraguay* and *Chili*, on the E. by the *Atlantic*,

Atlantic, on the S. by *Terra Antarctica*, and on the W. and S. by the *Great South Sea.*

It was diſcovered about 1519, by one *Ferdinand Magellan*, from whom it took its name?

8. *Of* TERRA ANTARCTICA.

Tyro. How is this country ſituate, and why ſo called?

Philo. *Terra Antarctica* ſignifies thoſe countries that lie between the *Antarctic* circle and the S. pole; the chief of which known are *New Zealand*, *New Guinea*, *New Holland*, and *Terra Auſtralis Incognita.* And now, *Tyro*, we proceed to

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SECT. II.

Of the AMERICAN *Iſlands.*

Tyro. WHAT are the principal *iſlands* in *America?*

Philo. They are 10, which are thus divided.

1. To the N. are		1. *California.* 2. *Newfoundland.*
2. *Middle* the *Antilles*	*Greater*	3. *Cuba.* 4. *Jamaica.* 5. *Hiſpaniola.* 6. *Porto Rico.*
3. To the S. are	*Leſſer.*	7. *Caribees.* 8. *Lucayes.* 9. *Sotovento.* 10. *Bermudas.* 11. The *Iſland* of *Terra del Fuego.*

1. *Of* CALIFORNIA.

This iſland was once thought to be a peninſula, the N. part was diſcovered by Sir *Francis Drake* in 1577. It has *Mexico* on the E. and the *Pacific Ocean* on the W. it lies 35 degrees N. latitude.

2. *Of* NEWFOUNDLAND.

This iſland was diſcovered by the two *Cabots*, in the time of *Henry* VII. 1497; but more perfectly by *Thorn* and *Elcot* of *Briſtol*, in 1527. It lies between 47 and 51 degrees of N. latitude, near *New Britain*.

Avalon is its chief *Province*, which was built upon by Sir *George Calvert* in 1623, by a patent granted, and afterwards enjoyed by *Cæcilius* lord *Baltimore*. It is ſubject to the crown of *England*.

3. *Of* CUBA.

This iſland was diſcovered by the *Spaniards* in 1594. It lies N. of *Jamaica*, N. W. of *Hiſpaniola*, and S. of the *Bahama iſlands*. It lies between 19 and 23 degrees N. latitude, and extends to about 8 degrees of longitude. It is ſubject to the king of *Spain*, and the chief towns are the *Havanna* and *St. Jago*.

4. *Of* JAMAICA.

This was diſcovered by one *Columbus*, and poſſeſſed by *Penn* and *Venables* in *Oliver's* time. It was firſt called *St. Jago*, but afterwards *Jamaica*, in honour of *James* duke of *York*.

It lies S. of *Cuba*, and W. of *Hiſpaniola*, and between 18 and 19¼ latitude, and extends to about 3 degrees of longitude.

It is ſubject to the *Engliſh*. Its chief town is *Port Royal*.

5. *Of* HISPANIOLA.

This was diſcovered alſo by *Columbus* in 1492. It lies between 17 and 20 degrees of N. latitude. It has *Cuba* on the N. W. *Jamaica* on the W. and *Porto Rico* on the E. It is chiefly ſubject to the crown of *Spain*; and its principal town is *St. Domingo*.

6. *Of* PORTO RICO.

Porto Rico (once called *Johannis Inſula*, and by the natives *Bonquin)* lies E. of *Jamaica*, about 18 N. latitude. It takes its name from the city and haven of the ſame name.

7. *Of the* CARIBBEE *Iſlands.*

Tyro. Why are theſe iſlands ſo called?

Philo. From the inhabitants, who upon firſt diſcovery were found to be *Canibals*, and the word is taken for the ſame. They repreſent the ſegment of a circle, are about 30 in number, and extend from about 17 degrees N. almoſt to *Terra Firma*.

The chief among them are, 1, *Anguila*. 2, *St. Martin*. 3, *Sancta Crux*. 4, *Barbada*. 5, *St. Chriſtopher's*. 6, *Nevis*, or *Mevis*. 7, *Antego*. 8, *Montſerat*. 9, *Guadalupa*. 10, *Marigalant*. 11, *Dominica*. 12, *Martinico*. 13, *Barbadoes*. 14, *St. Lucia*. 15, *St. Vincent*. 16, *Grenada*. And 17, *Tabago*.

Note, Some of theſe belong to the *Engliſh*, ſome to the *French*, and others to the *Dutch*. The chief of theſe is *Barbadoes*, about 13½ degrees N. latitude. It is ſubject to the *Engliſh*.

8. *Of the* LUCAYES.

Tyro. Why are theſe ſo called?

Philo. From *Lucayone*, the longeſt of them all. They extend from *Tegeſta* in *Florida*, to the N. of *Hiſpaniola*.

The chief of which are, 1, *Babama*. 2, *Lucayone*. 3, *Cignatio*. 4, *Guanahani*. 5, *Tuma*. 6, *Tama*. 7, *Samana*. And 8, *Maiaguana*.

The principal of theſe is *Babama*, near *Cape Florida*, and remarkable for ſpiders, they being about 2 inches long in general, having 6 eyes.

9. *Of the* SOTOVENTO.

Theſe are ſo called by the *Spaniards*, to whom they chiefly belong, and are found from E. to W. along the coaſt of *Terra*

Terra Firma. The principal of them are, 1. *Tinidada.* 2. *Margarita.* 3. *Fortuga.* 4. *Orchilla.* 5. *Rocca.* 6. *Bonayre.* 7. *Curacao.* And 8. *Oruba.*

10. BERMUDAS.

Bermudas, ſo called from *John Bermudas*, a *Spaniard*, who firſt diſcovered it. It lies between 32 and 33 degrees of N. latitude, E. of *Carolina*; viz. about 240 Engliſh leagues, and is ſubject to the crown of *Great-Britain.*

11. *Of* TERRA DEL FUEGO.

This (according to ſeveral Hiſtorians) is ſo called, on account of ſeveral volcanos. It is ſituate S. of *Magellanica*, and parted from the main continent by the *Streights of Magellan*, lying between 52 and 53 degrees S. latitude.

And thus, *Tyro*, I have given you a ſhort and conciſe account of every thing, as far as I could in this compaſs, and is ſufficient (if well underſtood) to ſatisfy the curioſity of any reader that is willing to improve himſelf by authors, qualifying him the better for thoſe that have treated more largely and particularly upon them.

And now, *Tyro*, we are come to that part in which I propoſed to teach you the uſe of the globes, called by ſome practical, by others experimental geography.

* * *

DIALOGUE V.

Between PHILO, *a Tutor, and* TYRO, *his Pupil, concerning the nature, deſcription, and uſe of the* GLOBES.

SECT. I.

Tyro. WHAT is a globe, or ſphere? *Philo.* A globe, or ſphere, is a ſolid, round body, contained under one ſurface; having a point in the middle called the center, from whence all lines drawn to the ſurface are equal.

Tyro. Pray how is a Globe generated or formed?

Philo. It is made by the rotation of a circle, or ſemi-circle, broad ways upon their axis: that is, a ſhilling, *&c.* preſſed upon its edge, by two pins oppoſite each other, and blown round, will naturally repreſent the formation, or ſhape of a globe.

Tyro. How many ſorts are there?

Philo. Two, one called the Terreſtrial, or earthly; the other the Celeſtial, or heavenly globe.

Tyro. What does the Terreſtrial Globe teach us?

Philo. By the Terreſtrial Globe we are taught the knowledge of earth and ſea; with the ſituation of places, their difference in latitude and longitude, and ſun riſing and ſetting; length of days and nights throughout the year, and the true diſtance from one place to another, *&c.* called Geography.

Tyro. What is the uſe of the Celeſtial Globe?

Philo. The Celeſtial Globe, not only teaches us the ſun's, but alſo the riſing and ſetting of the ſtars, together with their right Aſcenſion, Declination, Amplitude, Almicanter, Azimuth, Latitude, Longitude, and diſtance from each other, *&c.* called Aſtronomy.

Tyro. But I muſt know firſt what Almicanter, Azimuth, *&c.* mean.

Philo. That you ſhall know by and by: but firſt, you muſt learn the name of the appendants and different circles belonging to the Globe.

Tyro. Pleaſe then to let me know what they be?

Philo. I will, and only give yourſelf a little pains to learn the nature of them, and you will immediately be qualified to work ſome Problems directly.

SECT. II.

A further deſcription of the Globes, *with the* great Circles *and appendants belonging.*

Tyro. WHAT do you mean by great circles of the Sphere?

Philo. Great circles are ſuch as cut the globe into two equal parts, paſſing through the center: all ſuch as do not cut the ſphere into two equal parts, are called leſſer circles.

Tyro. Pray how many are the great circles?

Philo. The Equator, or Equinoctial, the Ecliptic, or Zodiac, the Brazen Meridian, the Horizon, and the Colures.

1. *Of the* EQUATOR.

Tyro. What is the Equator, or Equinoctial?

Philo. The Equator on the Terreſtrial, or Equinoctial on the Celeſtial Globe, is a line, or circle; that cuts the Globe in two equal parts, dividing the N. from the S. and upon the Globe is eaſily known by two broad lines running parallel to each other, and a fine hair line between them; it is divided into 360 equal parts, called degrees, beginning at the firſt Meridian (or ſign Aries) and is marked from 1 with 10, 20, 30, 40, *&c.* to 360, quite round.

Tyro. But there are other figures on the lower edge, or part of the Equator on the Terreſtrial Globe; are there not?

Philo. Not on all Globes. *Senex*'s globes, indeed (which, as I ſaid before, I would recommend) are alſo marked, from the meridian of *London*, with 10, 20, 30, *&c.* to 180 degrees to the right hand, or E. and backwards from *London*, with 10, 20, 30, *&c.* to 180, W.

Tyro. And, pray, what is the uſe of this?

Philo. The Equator ſhews you the longitude of any place, either E. or W. from the firſt meridian; and this lower line on *Senex*'s globe ſhews you the longitude of any place from *London*, which is very ready, eaſy, and uſeful. The Equinoctial is to ſhew the right and oblique aſcenſion, *&c.* of the ſun, or any ſtar, *&c.*

2. *Of the* ECLIPTIC *and* ZODIAC.

Tyro. What, or which is the Ecliptic?

Philo. The Ecliptic is another great circle of the ſphere, which cuts the Equator at the two points, Aries and Libra, making an angle at each point of 23 degrees, 30 minutes, which is its furtheſt, or utmoſt extent, either N. or S. from the Equator, as you will ſee more plainly hereafter.

Tyro. What is the Zodiac?

Philo. The Zodiac is a broad imaginary circle, which extends itſelf (according to the rules of Aſtronomy) eight degrees on each ſide of the Ecliptic, and is that which contains the 12 ſigns, and in which the planets perform their revolutions. The line in the middle drawn parallel, is called the Ecliptic; becauſe Eclipſes happen in, or near the line. It is called *Via Solis*, the Sun's Path, Way, or Motion. ⁂ Tho' in modern Aſtronomy, it is that circle, or path, thar the earth deſcribes to an eye placed in the center of the ſyſtem, viz. the ſun.

Tyro. Pray, Sir, tell me in what manner the Ecliptic is divided, for, I think, I have ſome notion of it?

Philo. The Ecliptic, (like the Equator) is divided into 360 degrees, but not numbered from 1, to 10, *&c.* as the

Equator is, but is divided into 12 equal parts, containing 30 degrees each, which are called Signs, and have different Names and Characters.

Tyro. Pleaſe to let me know them?

Philo. I will, and you muſt mind to get the names of them by heart, and the character belonging to each, ſo as to know them at ſight.

The SIGNS.

NORTHERN SIGNS.

Aries.	*Taurus.*	*Gemini.*	*Cancer.*	*Leo.*	*Virgo.*
♈	♉	♊	♋	♌	♍

SOUTHERN.

Libra.	*Scorpio.*	*Sagitarius.*	*Capricorn.*	*Aquarius.*	*Piſces.*
♎	♏	♐	♑	♒	♓

⁂ Take notice the firſt ſix are called the Northern, the other the Southern Signs, and you are to mind which are oppoſite to each other (for that is very material) as ♈ is oppoſite to ♎, ♐ to ♊, *&c.* for it will ſhew you the different times and ſeaſons of the year, *&c.* very readily, when you come to perform any operation.

Tyro. I will obſerve what you ſay, but pleaſe to tell me the ſignification of their names?

Philo. It is of no great ſervice; however, *Aries* ♈, or the *Ram*; *Taurus* ♉, the *Bull*; *Gemini* ♊ the *Twins*; *Cancer* ♋ the *Crab*; *Leo* ♌ the *Lion*; *Virgo* ♍ the *Virgin*; *Libra* ♎ the *Scales*; *Scorpio* ♏ the *Scorpion*; *Sagitarius* ♐ the *Archer*; *Capricorn* ♑ the *Goat*; *Aquarius* ♒ the *Water-pot*; and *Piſces* ♓ the *Fiſhes*.

N. B. The Ecliptic cuts, or interſects the Equator or Equinoctial, at the two points, or ſigns Aries ♈ and Libra ♎, viz. on the 21ſt of *March*, and the 22d of *September*, N. S. on which days the ſun is in the Equator, and has no declination, either N. or S. and days and nights are then equal to all the inhabitants on the globe, as you will plainly ſee by and by.

3. Of

3. *Of the* BRAZEN MERIDIAN.

Tyro. What is the Brazen Meridian?

Philo. The Brazen Meridian is another great circle, which divides the Globe into two equal parts. It is repreſented by a thick Braſs-Hoop, which ſurrounds the Globe, from N. to S. and divides the Equator into 2 equal parts, *viz.* the E. from the W. and is that on which the Globe itſelf is hung, or turns round upon by its Axis, the extremities of which are called the Poles.

Tyro. How is the Brazen Meridian marked, or divided?

Philo. Like the Equator and Ecliptic, into 360 degrees; but with this difference, it is divided into 4 nineties.

Tyro. In what manner pray?

Philo. From the Equator towards the N. and S. pole, the Meridian is marked with a cypher over the Equator thus, (0) and on each ſide, with 10, 20, 30, 40, 50, 60, 70, 80, and 90, which ends in each Pole. Then again, from each Pole to the Equator, on the other half of the

Meridian, is marked 10, 20, 30, 40, &c. to 90, which ends in the Equator.

Tyro. Then I plainly perceive by this, that as many degrees as one pole is elevated or raiſed, the ſame will the contrary pole be depreſſed?

Philo. Your notion is very juſt.

Tyro. But, pray, what is the principal uſe of this circle?

Philo. The Brazen Meridian ſhews you the latitude of places, and their difference of latitude, either N. or S. from the Equator: for the latitude of a place is the ſame as the elevation of the pole above the Horizon. That is, whatever figure, or number, the Horizon cuts the Meridian in, ſo many degrees is the pole elevated, which is the latitude, as you will more plainly ſee, when we come to ſpeak of latitude and longitude.

4. *Of the* HORIZON.

Tyro. What is the Horizon?

Philo. The Horizon is that great circle which divides the heavens and earth into two equal parts, one called the upper, and the other the lower Hemiſphere. There are two ſorts, the one called the ſenſible, or natural, the other the rational, or mathematical Horizon.

Tyro. What is the ſenſible Horizon?

Philo. The ſenſible Horizon is that which divides the viſible part of the heavens from the inviſible; and is that great circle which we ſee all around us (ſtanding upon any hill, or at ſea) and ſeems as if the heavens and earth coincided, or joined together.

Tyro. What is the rational Horizon?

Philo. The rational, or real Horizon, is that which paſſes through the center of the earth, and divides it (as was ſaid before) into the upper and lower Hemiſphere.

⁂ This rational Horizon is repreſented by that broad wooden circle, lying with its face upwards, having two notches cut in it, one on the N. and the other in the S. part, in which the Brazen Meridian is ſlipt, or moved up and down, with pleaſure: the poles of the Horizon are the Zenith and Nadir.

Tyro. Pleaſe to give me a further deſcription of the *Horizon?*

Philo. There are four circles on the face of the wooden *Horizon*; viz.

1. The inner circle, or that circle at the inward edge next the globe, is divided into 12 equal parts, or ſigns, anſwering to the 12 ſigns in the *Ecliptic*, with their names likewiſe prefixed to them. As to this ſign ♈, is wrote *Aries.* this ♉, is wrote *Taurus*, &c. of the reſt. *Note.* *Aries* ♈ is in the E. *Libra* ♎ in the W. *Cancer* ♋ in the N. and *Capricorn* ♑ in the S. point of the *Horizon.*

2. Next to theſe ſigns is a *Calendar* of months, according to the *Julian* account, or *Old Stile* (uſed in *England* till the year 1752;) ſo that inward circle being divided into degrees, anſwers the days of the month; for right againſt the day is the degree of each ſign the ſun enters in on any day: or, *vice verſa*, right againſt the ſign, or degree, is the day of the month anſwering thereto.

3. Next to this is another *Calendar* according to the *Gregorian* account (done by pope *Gregory* XIII. in the year 1582)

called the *New Stile*, which is 11 days ſooner, or before the *Old Stile*, as you may ſee by the poſition of the *Calenders*, the 10th of *March* in the firſt, or *Old Calendar*, being right againſt the 21ſt in the *New*, or *Gregorian Calender*. This *New Stile* is now uſed by us in *England*, as well as in foreign nations, purſuant to an act of parliament in 1751.*

Laſtly. On the outward verge off the *Horizon* is the circle of the *Winds*, or *Rhumbs*; viz. the *Mariner's* compaſs being 32 in number (beginning at the N.) each *Point.* or *Rhumb*, contains 11¼ degrees; for 32 multiplied by 11¼ makes 360.

Tyro. Sir, I thank you kindly. Pray tell me now the uſe of the *Horizon*?

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* ☞ *Note*. Though this deſcription of the *Horizon* anſwers moſt globes, yet you are to obſerve, that on *Senex*'s globes (and I ſuppoſe others) made ſince the alteration of the ſtile, 1752, the *New Stile* is put upon the inner circle next the ſigns on the *Horizon*, and the *Old Stile* is outward. But this can be no difficulty; for it is very eaſy to be ſeen which is the *New*, and which is the *Old Calendar* on any globes; the *New* being 11 days before the *Old*, ſo that one being known, the other will eaſily be known alſo.

Philo. The *Horizon* ſhews the *riſing* and *ſetting* of the ſun, length of days and nights: alſo the *riſing* and *ſetting* of the ſtars in any latitude; together with the *Azimuth*, *Amplitude*, *Amicanter*, &c. of the ſun, or any ſtar, and the point they riſe or ſet upon, *&c.*

5. *Of the* COLURES.

Tyro. Pray what are the *Colures?*

Philo. The *Colures* are two *great* circles, cutting the *Equator* at right angles, and paſs through the pole of the world.

The *Soliſtial Colure* is that *great* circle which paſſes through *Cancer* and *Capricorn*, ſhewing *Winter* and *Summer*.

The *Equinoctial Colures* paſs through *Aries* and *Libra*, and ſhew the *Spring* and *Autumn*.

And now having given you a full deſcription of the principal circles; I propoſe to deſcribe the *leſſer*, and ſhew you more of the nature of the globe, and the appendants belonging.

DIALOGUE VI.

Concerning the leſſer *circles of the* Sphere, *commonly called* parallel *circles.*

SECT. I.

Tyro. WHAT do you mean by the *leſſer*, or *parallel* circles?

Philo. All ſuch circles as do not divide, or cut the globe into two equal parts; but that cut off any ſegment, or part, leſs than the half, are *leſſer* circles.

Tyro. Why are they called *parallel* circles?

Philo. Becauſe they are *parallel* every where to the *Equator*.*

Tyro. Pray tell me the names of the *leſſer* circles?

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* In the *Latitude* or *Parallel* of *London*, á degree contains about 37 ~~miles on the~~ *Equator*.

Philo. They are the *Tropics* and *Polar Circles.*

1. *Of the* TROPICS.

Tyro. Pray which are the *Tropic Circles?*

Philo. Look for the ſign *Cancer* on the globe, and you will find a circle drawn with a double line from thence round the *Globe*, parallel to the *Equator*, which is called the *North Tropic*, or *Tropic* of *Cancer*, being 23½ degrees from the *Equator* northward, ſhewing the ſun's greateſt northern declination. Then looking for the ſign *Capricorn*, you will find the ſame ſort of circle, which is called the *Southern Tropic*, being alſo 23½ degrees from the *Equator*, and ſhews the ſun's greateſt ſouthern declination, or variation from the *Equinoctial.*

2. *Of the* POLAR CIRCLES.

Tyro. Which are the *Polar Circles?*

Philo. They are two ſmall circles, lying near the poles (viz. 23½ degrees diſtance)

diſtance) drawn alſo with double lines: that on the N. is called the *Arctic Circle*, and that on the S. the *Antarctic Circle.* Theſe circles are the poles of the *Ecliptic.*

Tyro. Pray what is their uſe, or what do we learn from them?

Philo. All thoſe inhabitants that live under theſe lines have their longeſt day juſt 24 hours long, and their longeſt night the ſame (ſave the benefit of twilight, which is but trifling.) If you go further to the poles, their days are 2, 3, and 4 days, or 2, 3, 4, or 6 months long, as you will find demonſtrated in the problems.

Tyro. Surprizing! I long to ſee thoſe places, having heard of ſuch things, but always looked upon them as idle tales.

Philo. You may depend upon the truth of it, and will ſoon ſee the reaſon. But, now, we will ſhew you the *Appendants* belonging to the globes.

SECT. II.

Of the Appendants *belonging to the* Globes.

Tyro. WHAT do you mean by *Appendants?*

Philo. *Appendants* are in ſome reſpects the ſame as *Appurtenances*, being ſuch neceſſary things, both moveable and immoveable, as belong to globes; the principal, or chief of which, are as follows.

1. *Of the* Hour Circle, *or* Index.

Tyro. Pray what is *Hour Circle* and its uſe?

Philo. The *Hour Circle*, called alſo the *Horary Circle*, or *Dial Plate*, is a ſmall circle of braſs, divided into 24 hours; the upper 12 repreſents noon, and the lower 12 midnight. It is ſkrewed on the meridian round the N. pole, and on the pole itſelf is placed the *Index*, or *Hand*, which turns round with the globe.

Its uſe is to tell the time of the riſing and ſetting of the ſun, or ſtars, in any latitude; and what o'clock it is in any part of the world, *&c.*

2. *Of the* Quadrant *of* Altitude.

Tyro. Pray what is the *Quadrant* of *Altitude?*

Philo. This is a thin piece of pliable braſs, divided into 90 degrees, anſwering the degrees of the *Equator*, beginning at the lower end with (0) to 10, 20, 30, *&c.* to 90. At which figure it has a nut, which ſlips upon the meridian at pleaſure, and is faſtened thereto by a ſkrew.

Tyro. Pray what is the chief uſe of this *Appendant?*

Philo. Its uſe is to tell the height of the ſun, or ſtars, at any hour, and when they are due E. and W. Alſo the diſtance of the ſtars from one another, and the diſtance of one place from another on the terreſtrial globe, *&c. &c. &c.*

3. *Of the* Semi-circle.

Tyro. What is the *Semi-circle* of poſition?

Philo. It is a thin piece of braſs, divided into 180 degrees, anſwering one half of the *Equator.* It may be called a double *Quadrant* of *Altitude*, but is uſed only in ſome particular problems, the *Quadrant*, or *Horizon*, ſupplying its place.

4. *Of the* Nautical Box, *or* Mariner's Compaſs.

Tyro. What is the *Nautical Box*, and its uſe?

Philo. This is an inſtrument uſed in navigation, having the 32 points of the wind marked, or drawn, on a *Card*, or *Sea Chart*, and an index being touched with the load-ſtone points always northward. This *Card*, or *Chart*, is hung in an *Horizontal Plane*, and fixed on any part of the *Horizon* of the globe, or elſewhere,

where, to ſhew what point of the compaſs you are ſailing upon, or are in.

SECT. III.

Concerning the different names of the Sphere, *according to its different poſition, or ſituation.*

Tyro. WHAT do you mean by the *Sphere*'s having different names according to its poſition? I do not underſtand you.

Philo. Obſerve then. There are 3 ſorts of *Spheres*; viz. *a Parallel, a Right*, and an *Oblique Sphere*.

1. *A* Parallel Sphere.

A Parallel Sphere *has this poſition.*

1. The poles are in the *Zenith* and *Nadir*; that is, one pole is right up, and the other right underneath. 2. The *Equator* will be in the *Horizon*.

The

The Property *of this* Sphere.

The inhabitants of this *Sphere* are thoſe that live under the poles, and have the longeſt days and nights of any other inhabitants; their ſhorteſt day being 24 hours long, and their longeſt 6 months.*

2. *A* right Sphere.

A right Sphere *has this poſition.*

1. The poles will lie, or be in the *Horizon.* 2. The *Equator* will be in the *Zenith* and *Nadir.* 3. The *Equator* and all the leſſer circles will cut the *Horizon* at right angles; viz. perpendicularly.

The Property *of this* Sphere.

The inhabitants of this *Sphere* are thoſe who live under the *Equinoctial Line,* or *Equator,* and have their days and nights always equal; viz. 12 hours each.

3. *An*

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[*] See p. 91, 92, under the definition of climates.

3. *An* Oblique Sphere.

An *Oblique Sphere* is that poſition of the globe. that has the 3 following properties; viz. 1. One pole is as much above the *Horizon* as the other is underneath. 2. The *Equator* is part above, and part under the *Horizon.* 3. The *Equator* and all the parallel circles cut the *Horizon* obliquely.

The Property *of this* Sphere.

The inhabitants of this *Sphere* are thoſe that live in all other parts, except under the *Poles* and *Equinoctial Line.*

* * *

SECT. IV.

Of the different names of the inhabitants of the Globe, *in reſpect of their ſituation.*

Tyro. YOU have already told me the three different poſitions of the *Sphere*;

Sphere; pray what do you mean by the names of the ſeveral inhabitants?

Philo. Without any conſideration of the different poſition of the *Sphere*, theſe inhabitants have different names, according to the ſeveral meridians and parallels they lie under.

Tyro. Pleaſe to tell me their different names?

Philo. There are 6 different inhabitants; 1. *Antœci.* 2. *Periœci.* 3. *Antipodes.* 4. *Amphiſcii.* 5. *Periſcii.* And 6. *Heterocii.*

1. *Of the* ANTÆCI.

The *Antœci*, or *Antœcians*, are thoſe inhabitants that have the ſame longitude, that is, lie under the ſame meridian, having as many degrees latitude S. as we have N.

Their Property.

1. Their hour is the ſame as ours, it being noon, *&c.* with both at the ſame time. 2. Their days are equal to our

nights, and *vice verſa.* And 3. Their ſummer is our winter.

2. *Of the* PERIÆCI.

The *Periæcians* are thoſe that lie under the ſame parallel of latitude, on the ſame ſide of the *Equator*, only are diſtant 180 degrees of longitude; *viz.* a ſemicircle.

Their Property.

1. They have contrary hours, being noon with them when it is midnight with us. 2. Their days and nights are of the ſame length of ours. 3. Their ſeaſon, or time of the year, is alſo the ſame with us.

3. *Of the* ANTIPODES.

The *Antipodes* are ſuch inhabitants as have the ſame latitude S. as we have N. but differ 180 degrees in longitude. That is, they have oppoſite parallels, and oppoſite meridians.

Their Property.

Theſe inhabitants are (as it were) compounded with the former. For, 1. Their hour is contrary, being noon with one, when it is midnight with the other. 2. The longeſt day of the one is the ſhorteſt day, or longeſt night to the other. And 3. The 4 ſeaſons are contrary, their ſummer being our winter, *&c. &c.*

Tyro. It is wonderful indeed! I have often heard, it is true, that there are ſuch perſons as walk feet to our feet (that is, go with their heads downwards in reſpect of us:) pray are not the *Antipodes* this ſort of people?

Philo. They are, and however ſtrange it may ſeem, it is very truth itſelf; and this you will eaſily ſee, when you come to the problems, if you will but bear a little patience.

Tyro. Sir, I am obliged to you, and will be content till then. Pleaſe now to tell me concerning the other three inhabitants?

Philo. They have their names from the different poſitions of their ſhadows.

4. *Of the* AMPHISCII.

They are ſo called becauſe their ſhadows are caſt different ways at different times of the year; that is, their ſhadow is *Southward* from *March* to *September*; and *Northward* from *September* to *March*. Therefore, it is eaſy to perceive that theſe are inhabitants living in the *Torrid Zones*, that is, between the *Equator* and the two *Tropics*.

5. *Of the* PERISCII.

Theſe are ſo called becauſe they have their ſhadows go quite round them. Such, therefore, are the inhabitants that dwell between the *Polar Circles* and the *Poles*, that is, from 66 ½ degrees of latitude, to 90.

6. *Of the* HETEROSCII.

They are ſo called, as having their ſhadow caſt but one way, that is, either always towards the N. or always towards the S.

Theſe then are ſuch as live in the *Temperate Zones*; that is, between the *Tropics* and the *Polar Circles*. Thoſe in the *South Temperate Zone* have their ſhadow caſt always *Southward*; and thoſe in the *North Temperate Zone* have their ſhadows always caſt *Northward*, as in *England*, *France*, *Spain*, and almoſt all *Europe*.

* * *

SECT. V.

Of the ZONES, *or* CLIMATES.

1. *Of the* ZONES.

Tyro. WHAT do you mean by the *Zones*?

Philo. A *Zone*, or *Girdle*, is a tract, or ſpace, that ſurrounds the ſurface of the earth, as a *Belt*, or *Girdle* does the body.

Tyro. How many *Zones* are there?

Philo. Three; *viz.* 1. *Torrid.* 2. *Temperate.* And 3. *Frigid Zones.*

Tyro. You gave me an account of their different ſituation in the laſt ſection; be pleaſed, now, to tell me their extent, that I may have a better idea of the diviſion of the globe?

Philo. You remember that I told you from the *Equator* to either pole is 90 degrees; therefore, from the N. to the S. *Pole* is 180 degrees. Obſerve then,

1. The *Torrid Zone* extends from the *Equator* to the *Tropic* of *Cancer Northward*, and to the *Tropic* of *Capricorn Southward* 23½ degrees each; (very nearly) *viz.* 47 degrees in all.

2. The *Temperate Zones* extend themſelves from the two *Tropics* to the *Polar Circles* on both ſides the *Equator*; viz. 43 degrees each, being together 86 degrees.

3. The *Frigid Zones* extend from the *Polar Circles* to the *Poles*, being each 23½

degrees; viz. 47 in breadth; ſo that 23 ½, 43, and 23 ½, make 90 degrees; the diſtance from the Equator to either Pole. Or rather thus, the *Torrid Zones* contain 47 degrees, the *Temperate* 86, and the *Frigid* 47, in all 180 degrees.

Tyro. Sir, I thank you for this explanation, it is very plain to be underſtood: pleaſe, now, to tell me what you mean by the climates?

2. *Of the* CLIMATES.

Philo. Climates are tracts, or circles, upon the ſurface of the globe, of ſuch a certain breadth from the Equator to either Pole, that the length of the artificial day (*viz.* from the ſun riſe to ſun ſet) is juſt half an hour longer than in the next Climate nearer the Equator, till you come to the Polar Circles, and then, indeed, the day differs in each Climate one entire month.

Tyro. How many Climates * are there that differ by the half hour, and how many by the entire month?

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* *England* and part of *Scotland* is in the 19th *Climate*; *viz.* from about 51 ½, to 54 ½ degrees latitude, that is, near

Philo. There are 60 Climates in all; *viz.* 30 on each ſide of the *Equator*, called accordingly *North* and *South:* of theſe 60, 48 of them extend from the *Equator* to the *Polar Circles*, and each differ by half hours. And the remaining 12 are contained between the *Polar Circles* and the *Poles*, each differing one entire month from the other *.

DIALOGUE VII.

An explanation of the moſt uſeful terms uſed in Geography *and* Aſtronomy.

SECT. I.

Tyro. YOU have, Sir, given me a very plain and ſatisfactory account of the nature and properties of the globe: I will

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near 3 degrees extent. For the extent of all the *Climates*, ſee *Gordon's Grammar.* DEF. 17.

* See page 83.

I will now trouble you to explain the terms to me; for what can I do, till I know the ſignification of ſuch words as are uſed in the ſcience?

Philo. It is very true, and I will explain them as well as I am able; and, pray, be careful to get them by heart, though not juſt in the very words I tell you, yet ſo as to know the meaning of them, and the practical part will then eaſily follow; for the want of this is the chief occaſion that moſt learners are ſo deficient in what they undertake.

Tyro. You may depend upon my care.

Philo. Very well; I am ſatisfied, in hopes of your keeping your promiſe.

Explanation *of the* Terms, *&c.*

1. *Zenith*, is that point of the heavens that is right over head.

2. *Nadir*, is that point right under feet, being directly, or diametrically oppoſite to the Zenith.

3. *Zenith Diſtance*, is the number of degrees that the ſun, or any ſtar, wants

of 90 degrees, when they are upon the meridian, or greateſt height.

4. *Altitude*, is height. *Meridian Altitude*, is the greateſt Altitude, or height, at 12 o'clock.

5. *Declination*, is the diſtance of the ſun, or any ſtar, from the Equator, or Equinoctial, counted on the Brazen Meridian in degrees, and is called *North*, or *South*, according to which ſide of the Equinoctial, the *Declination* is.

6. *Right Aſcenſion*, is an Arch of the Equinoctial, contained between the ſign Aries ♈, and the degree of the Equinoctial that is cut by the Brazen Meridian, when the ſun, or ſtar, is brought to the Meridian.

7. *Oblique Aſcenſion*, is that Arch, or Degree of the Equinoctial, contained between the ſign ♈, and the degree of the Equinoctial, which is cut by the Horizon at the riſing of the Sun, or Star.

8. *Oblique Decenſion*, is juſt the reverſe, being the Degree of the Equinoctial, cut by the Horizon at the ſetting of the Sun, or Star.

9. *Aſcenſional Difference*, is the difference of degrees between the right and oblique Aſcenſion, which converted into time, by allowing 15 degrees for every hour, ſhews how much the ſun, or ſtar, riſes, or ſets, before, or after ſix. That is, ſubtract the oblique from the right Aſcenſion, tells the Aſcenſional Difference.

10. *Amplitude*, is an Arch of the Horizon, contained between the true E. and W. point, at the riſing and ſetting of the ſun, or ſtars, counted in degrees from the E. and W. points of the Horizon where they riſe and ſet, and is called *North*, or *South Amplitude*, accordingly.

11. *Azimuth*, is in effect the ſame as *Amplitude*, ſave only with this difference; that whereas Amplitude is only at riſing and ſetting, Azimuth ſhews the diſtance from the E. and W. points, at any time, when the ſun, or ſtars, are above the Horizon *.

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* *Note. Azimuth* is not expreſſed alike in all authors. Some call it always *North*, or *South Azimuth*, and reckon the *Azimuth* from theſe two points eaſtward, or weſtward. Others reckon it from the E. and W. points, either

12. *Elevation* of the pole, is the ſame as *Latitude.* There are three ſorts; viz.

1. *Latitude* of a place, is its diſtance from the Equator, either North or South, numbered in degrees on the Brazen Meridian: or, in other words, it is the Elevation of the pole above the Horizon.

2. *Latitude* (in Navigation) is the diſtance of a ſhip from the Equinoctial, counted on the Meridian. So that if a ſhip ſails towards the Equinoctial, ſhe is ſaid to depreſs the pole; and if ſhe ſails from the Equinoctial, ſhe is ſaid to raiſe the pole.

3. *Latitude* of a ſtar, is its diſtance from the Ecliptic, being an Arch of a circle of Longitude, reckoned from the Ecliptic towards its pole, either N. or S.

13. *Longitude* is alſo of three ſorts; viz.

1. *Longitude* of a place, is an Arch of the *Equator*, intercepted between the firſt

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either northward, or ſouthward, which, I think, is beſt, they being the two points that *Azimuth* is neareſt to in our, or any leſſer latitude, at any hour: however it matters not which, if you mind this one rule; ſuppoſe I ſay, the ſun has 60 degrees *Azimuth* from the N. eaſtward, it is the ſame as if I ſay he has 30 degrees *Azimuth* from the E. northward. See PROBLEM XXI.

firſt *Meridian*, (or point *Aries* ♈) on the *Equator* and the *Meridian* of the place.*

2. *Longitude* of a ſtar, is an *Arch* of the *Ecliptic*, counted from the beginning of *Aries*, to the place where the ſtar's circle of longitude croſſes the *Ecliptic*; ſo that it may be ſaid to be the ſtar's place in the *Ecliptic*, counted from the point *Aries*, which cannot exceed 180 from the *Equinoctial* point.

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* *Note. Longitude* of places differ according from what firſt *Meridian* they are counted. Thus, upon ſome globes, *London* is 23 degrees E. longitude, on others 20, *&c.* and on *Senex's* globes all 18 degrees E. longitude of the firſt *Meridian*: For ſome place their firſt *Meridian* at *Gratioſo*, others at *Teneriff*, and *Senex* at *Ferol*. But this matters not at all; for when you know the difference (as you will ſoon ſee that by practice) you will know to work by either, and have the ſame anſwers.

N.B. In reckoning of longitude from *London*, you will find all 18 degrees from *Aries* eaſtward on *Senex*'s globe, a cypher (0) under the lower part of the *Equator*, under the meridian of *London*, and there begins the longitude from *London*; viz. 180 degrees eaſtward, and 180 degrees weſtward, numbered by 10, 20, 30, *&c.* to 180. *Note* further, That no longitude exceeds 180; for 181 E. is more properly 179 W. longitude.

3. *Longitude* (in *Navigation*) is an *Arch* of the *Equator*, contained between the firſt *Meridian* and the *Meridian* the ſhip is in.

Tyro. I humbly thank you, Sir; for theſe definitions, which when well underſtood, muſt render the uſe of the globes very familiar?

Philo. Indeed, my dear pupil, there can be nothing hard in the practical part, when once you have a tolerable notion of what I have ſhewn you.

But, becauſe I would have you underſtand yet more, I have inſerted the following tables (contrary to any other ſmall treatiſe I ever ſaw) that you may not be at a loſs, when you work ſome choice *Problems*, but refer both for inſtruction and confirmation.

S E C T. II.

Containing three neceſſary and uſeful TABLES: viz.

T A B L E I.

A TABLE *of the Latitude and Longitude of the moſt principal Places, from the lateſt obſervation.*

N. B. The longitude here is taken from the meridian of London, which is 18 degrees E. of the firſt meridian *Ferol* (on *Senex's* globe:) ſo that by adding, or ſubtracting, 18 degrees, you have the longitude from the firſt meridian, that is, by knowing one you may know both; the Equator being marked, or graduated, for both.

Places.	Latitude.	Longitude.
A.		
Adrinople, Turkey, in Europe	[illegible] N.	[illegible] E.

SECT. II.

Containing three neceſſary and uſeful TABLES; viz.

TABLE I.

A TABLE *of the* Latitude *and* Longitude *of the moſt principal* Places, from the lateſt *obſervation.*

N. B. The longitude here is taken from the meridian of *London*, which is 18 degrees E. of the firſt meridian *Ferol* (on *Senex*'s globe:) ſo that by adding, or ſubtracting, 18 degrees, you have the longitude from the firſt meridian, that is, by knowing one you may know both; the *Equator* being marked, or graduated, for both.

Places.	Latitude.			Longitude.		
A.	°	′		°	′	
Adrinople, Turkey, in Europe	43	30	N.	27	24	E.

Aix la Chapelle, in Weſtphalia	50	48	N.	7	00	
Aleppo, Syria, in Aſia	36	50		38	30	
Alexandria, Egypt, in Africa	31	25		30	50	
Amſterdam, in Holland (and capital)	52	29		5	15	
Archangel, in Ruſſia	64	30		42	10	
B.						
Babylon, in Chaldea (called Bagdad)	34	45		48	45	
Barbadoes, in the Weſt-Indies	13	14		59	50	W.
Bengal, in the Eaſt Indies	21	00		88	00	E.
Berlin, Upper Saxony, in Germany	52	10		13	40	
Bologne, Picardy, in France	50	36		1	50	
Boſton, in New-England	43	10		69	30	W.
Briſtol, in England	51	33		2	34	
C.						
Cadiz (Andaluſia, in Spain (and capital)	36	30		5	45	W.

Places.	Latitude.			Longitude.		
	°	′		°	′	
Cairo, Egypt, in Africa	36	5	N.	40	00	W.
Candia, in the Iſland of Candia	34	55		24	50	E.
Canterbury, in Kent	51	10		1	6	
Canton, in China	23	12		112	52	
Candy, in the Iſland of Ceylon	8	15		80	30	
Cape of Good Hope, S. of Africa	34	45	S.	18	00	
Cochin China, Eaſt Indies	13	00	N.	107	00	
Colcheſter, in Eſſex	51	56		0	50	
Conſtantinople, Romania, in Turkey (and capital)	41	40		29	40	
Copenhagen, Zeland, in Denmark (and capital)	55	40		12	35	
Corinth, Morea, in Turkey	38	00		22	25	
Cracow, capital of Poland	50	15		20	50	

Cremona, Milan, in Italy	45	10	N.	10	32	
Cyprus Iſland, in the Levant	35	00		34	00	
D.						
Dublin, capital of Ireland	53	50		7	20	W.
Dunkirk, Flanders	51	7		2	30	E.
E.						
Edinburgh, capital of Scotland	55	56		3	00	
Epheſus, Natolia, in Aſia.	37	50		27	35	
F.						
Frankfort, on the Oder, in Germany	52	28		14	35	
Frankfort, on the Main, in Germany	49	45		9	45	
G.						
Gibraltar, Andaluſia, in Spain	35	30		4	50	
Glaſgow, in Scotland	56	20		4	18	

Places.	Latitude.			Longitude.		
	°	′		°	′	
H.						
Hague, in Holland	52	10	N.	4	4	
Hanover, Saxony, in Germany	52	16		10	0	
J.						
Jeruſalem, Paleſtine, in Aſia	32	44		36	15	
K.						
Koningſburgh, Pruſſia, in Poland	54	55		22	15	
L.						
Lima, in Peru, in South America	11	30	S.	78	40	W.
Liſbon, capital of Portugal	38	45	N.	8	20	
London, capital, or metropolis, of England	51	32		0	0	

M.						
Madagaſcar, an iſland in Africa	19	29	S.	43	55	E.
Madrid, New Caſtile, in Spain (and capital)	40	10	N.	3	28	W.
Malta, near Sicily, in Mediterranean	39	10		4	00	E.
Moſcow, capital of Muſcovy	55	30		39	30	
N.						
Nankin, or Nanquin, in China	31	00		118	30	
Naples, in Italy	41	45		14	50	
O.						
St. Omer's, in France	50	50		2	20	
P.						
Panama, North America	8	30		82	30	W.
Paris, capital of France	48	45		2	20	E.

Peterſburgh

Places.	Latitude.			Longitude.		
	°	'		°	'	
Peterſburgh	60	00	N.	31	32	
Prague, capital of Bohemia, in Germany	50	00		14	25	
Preſburgh, in Hungary	48	22		15	30	
Pekin, in China	39	52		110	52	E.
Port Royal, Jamaica	18	00		77	5	W.
Q.						
Quebec, in Canada	47	10		70	15	E.
R.						
Rhodes Iſland, Archiapelago	35	30		29	15	
Rome, capital of Italy	42	8		13	7	
S.						
Siam, in the Eaſt-Indies	14	5		100	50	

Spires, Upper Rhine, Germany	49	0	N.	8	10	
Stockholm, capital of Sweden	59	30		19	5	
Syracuſe, Sicily	35	15		15	0	
T.						
Tangier, Barbary, in Africa	35	45		6	00	W.
Thyatira, Natolia, Aſia	38	28		28	32	
Tripoli, Barbary, Africa	33	55		13	50	
Tunis, ditto	35	30		12	40	
W.						
Warſaw, in Poland	52	10		22	00	
Y.						
York, in England	52	20		1	8	W.

TABLE II.

Shewing the ſun's place, declination, time of riſing and ſetting; length of days, and beginning and ending of twilight, one day in every month, for the latitude of London, *according to the* New Stile, 1752.

N. B. (°) ſtands for degrees (′) for minutes, H for hours, M. for minutes, ⊙ for the ſun, D. for declination, N. for North, S. for South.

Months.		⊙ Place			Declin.			⊙'sRiſ and Sett			L. of Days.		Twilight beg.		ends.
			°	′	°	′		H.	M.	H	H.	M.	H.	M.	H.
Jan.	20	♒	1	45	19	51	S	7	48	5	8	24	5	43	7
Feb.	19	♓	1	55	10	31	S	6	55	6	10	10	5	00	7
Mar.	22	♈	2	50	1	4	N	5	56	7	12	8	4	00	8
Apr.	22	♉	2	14	12	13	N	4	48	8	14	24	2	38	10
May	22	♊	1	11	20	25	N	4	8	8	15	44	12	30	12
June	22	♋	1	0	23	29	N	4	42	8	6	36	No Night till June the 20th		
July	21	♌	28	30	20	24	N	4	7	8	15	46		42	12
Aug.	20	♍	27	17	12	29	N	4	53	8	14	14	2	21	10
Sept.	19	♎	26	27	1	29	N	5	51	7	12	14	4	00	8
Oct.	19	♏	26	6	10	1	S	6	50	6	10	20	5	00	7
Nov.	18	♐	26	14	19	18	S	7	43	5	8	34	5	45	7
Dec.	22	♑	1	45	23	19	S	8	12	4	7	36	5	58	7

TABLE III.

A TABLE *of the right* Aſcenſion, Declination, Latitude, *and* Longitude *of ſome of the moſt eminent fixed* Stars, *taken from* Senex's *celeſtial* Globe, 1754, *for the uſe of the learner.*

Names and Conſtellations.	R. A.		Declin.			Lat.			Long.		
	°	′	°	′		°	′		°	′	
Aldebaran, in Taurus	65	15	16	15	N.	4	45	N.	6	00	♊
Alioth, in Urſa Major	189	30	57	30		54	00		6		♍
Alcair, in Aquila	293	45	8	30		29	30		28		♑
Albiero, in Cygnus	289	45	27	30		55	00		19		♒
Aridef, in ditto	307	45	44	30		59	30		3	30	♓
Acharnar, in Eridanus	23	30	59	30	S.	60	0	S.	13	00	♓
Alfeta, in Corona	230	45	27	15	N.	40	30	N.	8	00	♏
Arcturus. in Bootes	210	45	20	30		30	30		23	00	♎

Aſengue,

Names and Conſtellations.	R. A.		Declin.			Lat.			Long.		
	°	′	°	′		°	′		°	′	
Aſengue, in Lyra	277	00	38	30	N.	61	30		11	00	♑
Bellatrix, in Orion	77	30	6	15		15	45		17	00	♊
Betelgeuze, in ditto	84	30	7	30		24	30		16	15	
Benenaez, in Urſa Major	204	15	50	30		74	30		23	00	♍
Canobus, in Argo-Navis	95	30	53	0	S.	76	00		10	00	♋
Caſtor, in Gemini	109	80	32	30	N.	9	45	S.	16	00	
Caſtor's brother, Pollux, do.	111	45	28	30		7	00	N.	19	30	
Capella	73	00	45	45		23	00		17	00	♊
Cor Hydra, Hydra's Heart	138	30	8	15		22	30		24	00	♌
CorScorpio, Scorpio's Heart	243	00	26	00		4	45		5	45	♐
Cor Leo, called Regulus	148	00	13	00		0	45		26	00	♌
Deneb, in Leo Major	173	45	16	30		12	30		18	00	
Dubbee, in Urſa Major	175	00	55	30		47	30		27	30	
Enif, in Pegaſſus	322	15	8	45		22	30		28	00	♒

Fomahant	341	00	31	0	21	00	30	00	
Marhal, in Pegaſſus	342	15	13	30	19	00	20	00	♓
Mencar, in Cetus	41	36	3	15	12	00	10	00	♉
Procyon, in Canicula	111	00	6	00	15	00	22	00	♋
Pes Centaurus	216	30	59	30	42	30	26	00	♏
Regel, in Orion's Foot	75	15	9	15	31	00	12	30	♊
1. Star in the Girdle of Orion	79	30	1	00	23	00	17	30	
2. —— ditto	80	30	2	00	24	00	18	30	
3. —— ditto	81	15	3	00	25	30	19	30	♓
Scheat, in Pegaſſus	342	15	26	15	31	00	26	00	
Sheder, in Caſſiopea	5	30	55	15	46	30	3	80	♋
Sirius, in Canis Major	98	00	16	30	39	15	12	00	♎
Spica, in Virgo	198	00	9	45	2	00	20	00	♌
Upper Pointer, in Urſa Maj.	161	30	63	30	50	00	12	00	
Lower Pointer, ditto	161	20	58	00	46	00	16	00	♎
Vindemiatrax, in Virgo	192	00	12	30	16	00	5	30	

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DIALOGUE VIII.

Containing ſome uſeful and neceſſary Problems *on the* Terreſtrial Globe.

N. B. (°) ſtands for degrees (′) for minutes.

SECT. I.

Philo. YOU ſay, *Tyro*, that you underſtand what I have ſhewn you concerning the definition of the globes and the appendants that belong to them; and, if ſo, you are fit for the following problems: but, if you think you are not perfect, or do not rightly underſtand what *right Aſcenſion*, *oblique Aſcenſion*, *Azimuth*, *Almicanters*, &c. ſignify, or do not know what the greater, or leſſer, circles are, and the particular uſes of the *Meridian*, *Horizon*, *Colures*, *Quadrant of Altitude*, &c. then, pray, turn back and read them over once more, for you will find that your underſtanding of theſe things will be a great help to you.

Tyro. I thank you for your care; but I underſtand them in general very well.

Philo. Then I will directly proceed to

* * *

PROB. I.

The latitude being given to rectify the Globe *for that place.*

DEFINITION.

I Have already told you that the latitude of any place is the very ſame thing as the elevation of the pole above the *Horizon*; therefore, whatever the latitude be, ſuppoſe *London* 51° 32′ N. or *Madrid* 40° 10′ N. proceed thus.

Turn the pole on which the dial-plate is fixed towards the verge of the *Horizon*, ſlipping, or moving, the whole globe backwards, or forwards, in the notches of the *Horizon*, till the *Horizon* cuts the *Brazen Meridian*, in 51° 32′ (viz. a little more than 51½) ſo is the globe rectified for the latitude of *London*; that is, the N. pole will then be elevated 51° 32′ above the *Horizon*; and *London* being brought to the meridian itſelf will then be in *Zenith*, or right up, and at equal diſtance from all parts of the *Horizon*.

Depreſs the pole till the *Horizon* cuts the *Brazen Meridian* at 40° 10′ and you have then the poſition of the inhabitants at *Madrid*, and turning the globe, till *Madrid* comes to the meridian, you will find it in the *Zenith*, or top of the globe, under 40° 10′.

Note. If it were required to rectify the globe for S. latitude, then you muſt elevate the S. pole to the given latitude inſtead of the N. pole; but this is better explained by the next problem.

PROB. II.

The latitude and longitude of any place given, to find the ſame.

Firſt, YOU are to obſerve whether the longitude be reckoned frōm *London*, or from the firſt meridian; for on ſome globes the firſt meridian begins 23°, on others 20°, and on *Senex*'s globes, 180° W. of *London*; but if once you know where the firſt meridian is on the globe, it is very eaſy to know the difference from the meridian of *London*. As for *Engliſh* authors in general, the tables of longitude are counted from the meridian of *London*, and I herein follow the ſame.

See a farther account of longitude DIALOGUE VII. *Sect.* I *Defin.* XIII.

EXAMPLE.

There are two certain places, one has 18° N. latitude, and 77° 5′ W. longitude. The other is 33° 45′ S. latitude, and 18° E. longitude from *London*; I demand what places theſe are.

RULE.

For the firſt place, I elevate to the N. pole 18°, becauſe it is 18 N. latitude. Then I turn the globe to the right-hand, or eaſtward (becauſe the place lies weſtward) till 77° 5′ upon the equator, counted from the meridian of *London* (which on *Senex's* globe has a cypher thus (0) on the equator) paſſes through, or under, the meridian: or, in other words, I turn the globe, till 77° 5′ weſtward is brought under the meridian, and here I fix the globe with a quill thruſt in betwixt the globe and the *Horizon:* then I look under the latitude 18° (which is in the *Zenith*) on the meridian a-top of the globe, and under 18° on the meridian, I find *Port Royal* in *Jamaica* the place required.

For the ſecond place, I elevate the S. pole (though there is no occaſion to elevate the pole barely to find a place; but it is better, becauſe you have then the real ſituation of the inhabitants) to the given latitude 34° 45′, and then turn the globe till 18° E. longitude of *London* come under the meridian. Then I look under the latitude 34° 45′ on the meridian, and juſt under this I find the *Cape of Good Hope*, the place required.

Again, there are 3 places. The firſt 32° 55′ N. latitude, and 35° 15′ E. longitude. The other is 39° 50′ N. latitude, and 110° 52′ E. longitude: and the laſt is 7° 30′ N. latitude, and 80° 30′ E. longitude, I demand the places.

Anſwer, *Jeruſalem*, *Pekin*, and *Candea*, or *Candy*.

PROB. III.

The latitude of any place given, to tell all thoſe places that have the ſame latitude.

DEFINITION.

ALL thoſe places that have the ſame latitude, have the days and nights of the ſame length, at the ſame time;

but not the very ſame hour of the day. See *Sect.* IV. *Defin.* II.

RULE.

Bring the given place, or places, to the meridian (ſuppoſe *London* 51 ° 32 ′, and *Madrid* 40 ° 10 ′ N.) then turn the globe, and all thoſe places that paſs under 51 ° 32 ′, have the ſame latitude as *London*; viz. *Prague*, in *Germany*, &c. and all that paſs under 40 ° 10 ′, have the ſame latitude as *Madrid*, which you will find to be *Pekin* nearly for one, and many other places nearly the ſame.

* * *

PROB. IV.

To tell the difference of the latitude of places.

HERE are two variations, or rules. *Firſt*, If the latitudes be both N. or both S. then ſubtract the leſs from the greater latitude, and the remainder is the difference, or anſwer. Thus between *London* and *Madrid* is 12° 32′, the firſt being 52° 32′, and the other 40°. And between *Candy* and *Stockholm* is 52° 30′, for *Stockholm* is about 59° 30′ N. and *Candy* 7° 30′ N.

Secondly, If one place lie on the N. and the other on the S. ſide of the *Equator*; that is, if one be N. and the other S. latitude, then add them both together, and their ſum is the difference of the latitude required.

Thus *Copenhagen* is 55° 40′ N. and the iſland of *Madagaſcar* is 19° 30′ S. theſe added together make 75° 10′ the difference required.

* * *

PROB. V.

The longitude of any place given from any meridian, to tell thoſe places having the ſame longitude.

THIS is done after the ſame manner as the other, only here the anſwer will be on the *Equator*, as the others were on the meridian.

I would know what places have the ſame longitude as *London*, and the ſame longitude as *Moſcow*.

RULE.

Bring *Lnodon* to the meridian, then all thoſe places on the globe (from the N. pole to the S. part of the *Horizon)* that lie under the edge of the meridian, have the ſame longitude as *London*. Thus *Fort Naſſau*, and *Fort Mina* in *Guinea* have the ſame, or very nearly the ſame longitude as *London*.

And *Moſcow* in *Muſcovia* has very nearly the ſame longitude as *Aleppo* in *Syria*: alſo *Scandaroon*, *Antioch*, and *Tripoli* in *Syria* have the ſame longitude; viz. 37° 30′ from *London*.

PROB.

PROB. VI.

To tell the difference of the longitude of places. (See Prob. XXVI.)

DEFINITION.

☞ *Note* 1. No place can exceed, or be above 180 d. of longitude from another place; for 181 d. E. longitude is with more propriety 179 d. W. longitude, for 181 d. taken from 360 d. there remains 179 d. which is nearer to the given place than 181 d.

RULE.

HERE are alſo two variations as in *Prob.* IV. *Firſt*, If the places lie both E. or both W. of the firſt meridian, or where you reckon the longitude from; viz. if they both be E. or both W. longitude, then ſubtract one from the other you have the difference.

Thus I find *Jeruſalem* has 39° 15′ E. longitude from *London*, and *Pekin* 110° 52′ E. longitude; therefore I ſubtract 36° 15′ from 110° 52′, and there remains 74° 37′ difference of longitude E. or W. that is, *Pekin* is 74° 37′ E. longitude of *Jeruſalem*; or *Jeruſalem* is 74° 37′ W. longitude of *Pekin*.

Secondly, If one place be E. and the other W. longitude of the firſt meridian (ſuppoſe *London*, or any other meridian) then add their longitudes together, and the ſum is the difference of longitude required.

EXAMPLE.

I would know the difference of longitude between *Jeruſalem* 36° 15′ E. of *London*, and *Port Royal* in *Jamaica* 77° 5′ W.

Here as one is E. and the other W. I add 36° 15′, and 77° 5′ together, and their ſum makes 113° 20′ difference of longitude. That is, *Jeruſalem* is 113° 20′ E. of *Port Royal*, or *Port Royal* is 130° 20′ W. of *Jeruſalem*.

Note 2. If the difference of longitude after addition exceeds 180 d. take it out of 360 d. for that is the true longitude required. See *Note* 1.

EXAMPLE.

Pekin in *China* is 110° 52′ E. longitude, and *Port Royal* is 77° 5′ W. I add theſe ſums together, and find it 187° 57′ difference of longitude, but, becauſe it is more than 180°, I ſubtract 187° 57′ from 360°, and there remains 172° 3′, the difference required.

Tyro. Sir, I heartily thank you for this explanation, which I underſtand very well.

* * *

PROB. VII.

The day of the month given, to find the ſun's place in the ecliptic.

RULE.

THE day of the month being given, look on the inner calender on the new globes, and you have the ſign and

the

the degree of that ſign that the ſun is in for that day, according to the *New Stile.*

If it be upon old globes, look on the outward calender, you have the ſign and the degree of the ſign.

N. B. You may further obſerve, that the calender uſed throughout *Europe* is the calendar for *N. S.* viz. *New Stile*, and is always known from the other; becauſe it has the *Saints Days*, and ſeveral other things wrote upon it on the *Horizon.*

EXAMPLE.

I would know the ſun's place in the ecliptic, on *May* the 21ſt, *N. S. March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt.

I look for theſe days of the months in order as they ſtand in the new calender; viz. for *N. S.* before deſcribed, and right againſt the day of the month in the innermoſt circle on the *Horizon*, I find the ſun's place among the ſigns.

Thus right againſt *May* the 21ſt, I find 1° of ♊ *Gemini:* and alſo on *March* the 21ſt, I find he enters ♈ *Aries:* on *June* the 21ſt, he enters ♋ *Cancer:* on *September* the 22d he enters ♎ *Libra:* and on *December* the 21ſt he enters ♑ *Capricorn.*

☞ *Note.* That in every problem and operation, except *Old Stile* be mentioned, it is to be underſtood for *New Stile*; viz. *N. S.* and latitude always means N. latitude, except expreſſed S.

* * *

PROB. VIII.

The ſun's place given, to find the day of the Month.

RULE.

THIS is only the reverſe of the former problem: for having the ſun's place given, ſeek it in the innermoſt circle among the ſigns; then againſt that degree in the calender *N. S.* you have the day of the month required.

EXAMPLE.

I would know what time of the year the ſun is in 1° of ♊, as alſo when he enters ♈, ♋, ♎, and ♑? Proceed according to the rule, and you will find the days to be *May* the 21ſt, *March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt.

* * *

PROB. IX.

The latitude and day of the month given, to find the ſun's place in the ecliptic, and rectify the globes for uſe.

RULE.

FIND the ſun's place on the *Horizon* by *Prob.* VII. and having noted what degree he is in, look upon the ecliptic on the globe, and find the ſame ſign and degree as you did on the *Horizon*, then bring this degree of the ecliptic very carefully to the graduated edge of the *Brazen Meridian*, and holding the globe ſteady, turn the index exactly to the upper 12, which repreſents 12 at noon, and thus is the globe rectified for that day, and the degree of the ecliptic that lies under the *Equator*, repreſents the ſun's place at noon, or 12 o'clock, that day.

☞ The *Aſtronomer*'s day is reckoned from, or begins at, 12 o'clock; and, if you fix the quadrant of altitude to the latitude in the *Zenith*, the globe will be compleatly rectified: but more of this by and by.

* * *

PROB. X.

To tell the declination of the ſun on any day of the year.

DEFINITION.

DEclination of the ſun is his variation from the *Equator*, either northward or ſouthward.

N. B. His

N. B. His greateſt declination northward is 23 d. 30 m. which is on *June* the 21ſt, and his greateſt declination ſouthward is 23 d. 30 m. *December* the 21ſt: but on *March* the 21ſt, and *September* the 22d, when he enters ♈ and ♎, he has no declination at all, but is in the *Equator* itſelf; and then days and nights are equal to all the inhabitants on the globe.

RULE.

Having found the ſun's place in the ecliptic for the given day, bring it to the *Brazen Meridian*, and obſerve what degree of the meridian it lies under, and whether it be on the N. or on the S. ſide of the *Equator*, for that is the declination required, which is called N. or S. declination accordingly.

EXAMPLE.

Proceed according to the rule, you will find on *April* the 21ſt, the ſun has 11° 30′ N. declination, and on *May* the 21ſt, he has 20° 30′ N. declination: but on *October* the 27th, he has 12° 30′ S. declination, and on *January* the 30th, he has 16° S. declination nearly.

PROB.

PROB. XI.

The latitude and day of the month given, to tell the ſun's meridian altitude; viz. *his height at noon.*

RULE.

BRING the ſun's place to the meridian, and obſerve what degree of the meridian the ſun's place is under; for thoſe degrees on the meridian that are intercepted, or lie between the South verge of the *Horizon*, and the degree which is over the ſun's place on the meridian, counted on the meridian, is the ſun's meridian altitude required.

EXAMPLE.

I would know in the latitude 51° 30′, on *May* the 21ſt, the ſun's meridian altitude, as alſo his meridian altitude on *November* the 5th. I proceed according to the rule, and find his meridian altitude, *May* the 21ſt, to be 59°; but on *November*

November the 5th, he has but 23° 30′ altitude.

Proceed thus, and you will find his meridian altitude, in the latitude of 40°, on the ſame days, to be 70° 30′, and 34° 30′: but in the latitude of 20° 30′, on *May* 21, he will have 90° of altitude, or be right up that day to the inhabitants in that latitude, which ſhall be further explained by and by.

PROB. XII.

The latitude of the place (ſuppoſe London) *and the ſun's meridian height given, to tell the day of the month ſuppoſing it were loſt.*

RULE.

THIS problem is the reverſe of the laſt; for you are only to ſet the globe to the latitude, then count from the S. verge of the *Horizon*, as many degrees on the meridian upwards as the given height is; and under that degree of the meridian you have the ſun's place in the ecliptic, which ſeek in the circle of ſigns on the Horizon, gives the day required.

EXAMPLE.

In the latitude of 51° 30′, on two certain days, I obſerved the ſun's meridian altitude to be 59° and 23° 30′; I demand what days they are?

Proceed according to the rule, you will find the one is *May* 21, the other *November* 5.

PROB. XIII.

The latitude and day of the month given, to tell the ſun's altitude at any time.

EXAMPLE.

ON *May* the 21ſt, at 9 in the morning, and at 5 in the afternoon at *London*, I would know the ſun's altitude.

RULE.

RULE.

Rectify the globe for the latitude, and bring the ſun's place (1° ♊) to the meridian, and the index to the upper 12 on the dial-plate; then fix the quadrant of altitude in the Zenith; (viz. the left edge of the nut muſt be fixed on the meridian at 51° 30′) then turn the globe till the index points to the hour, viz. 9 in the morning; this done, fix the globe by thruſting in a quill between it and the Horizon; laſtly, turn the quadrant about, till the graduated or figured edge touch the ſun's place (viz. 1° ♊) and the degrees on the quadrant, counted from the Horizon upward on the quadrant, is his height at that time; viz. 43° 30′. Then turn the globe till the index points to 5 in the afternoon; and alſo turn the quadrant on the W. ſide, (without unſkrewing it) till it touches the ſun's place; and you have about 24° on the quadrant, his altitude at that time.

But at *North Cape* (viz. N. latitude 72) at 9 in the morning May 21, he will be but about 32° high.

PROB. XIV.

The latitude (ſuppoſe London) *and the ſun's altitude and day of the month given, to tell the hour.*

THIS is only the reverſe of the laſt problem, only it will have two anſwers; *viz.* the hour may be morning or afternoon.

RULE.

Rectify the globe as before deſcribed, and turn the globe and the quadrant on the E. ſide, till the quadrant touches the ſun's place at the given height, (which by the laſt, on *May* 21, at 9 in the morning, was found 43° 30',) then look at the index, and it will point to the hour; turn it W. till the ſun's place touch the ſame degrees on the quadrant on the W. ſide, and you will have the time in the afternoon.

EXAMPLE.

Thus on *May* the 21ſt, at *London*, when the ſun is 43° 30′ high, it is either 9 in the morning, or 3 in the afternoon.

Note. When the ſun's place and quadrant are on the E. ſide of the meridian it is morning hours; but when the ſun's place is on the W. part of the meridian, or weſtward of it, it is afternoon.

* * *

PROB. XV.

The latitude given, to tell the riſing and ſetting of the ſun, and length of the day and night at any time of the year.

RULE.

RECTIFY the globe (*viz.* elevate it for the latitude, bring the ſun's place to the meridian, and index to the upper 12,) then turn it till the ſun's place comes even with, or lies right againſt the inner verge on the E. ſide of the *Horizon*, then the index will ſhew you the time of the ſun's riſing; turn it to the W. ſide or verge of the horizon, and the index will ſhew you the ſetting. Or thus: having got the hour the ſun riſes, count how many it wants of 12; for ſo many hours will it ſet after. Thus; if the index points to 4 in the morning at riſing, it will of courſe riſe at 8 at night; if it points any day at half an hour paſt 4 at ſetting; both being four hours and a half from 12 at noon.

Note 1. If you double the time of riſing, that is, double the hours it wants of 12 at the time of riſing, it gives you the length of the Day from ſun-riſing to ſetting.

Note 2. If you ſubtract the length of the Day from ſun-riſing to ſun-ſetting, from 24, the remainder ſhews you the length of the night, twilight included. *See* Prob. 25.

Proceed thus, and you will find the ſun, on *May* 26, at *London*, to riſe about 4 in the morning, and ſet at 8 at night.

Now double what he wants of 12 at riſing, *viz.* 8 hours, and it gives the length of that day at *London*, *viz.* 16 hours.

But at *Madrid*, on the ſame day he riſes about ¾ paſt 4, ſets ¼ paſt 7 at night. And at *Stockholm*, on the ſame day he riſes at about ¼ paſt 3, and conſequently the days are 17 ½ hours long there.

* * *

PROB. XVI.

To tell the length of the longeſt and ſhorteſt day at London, *and at* Stockholm, *latitude* N. 59° 30′.

RULE.

YOU proceed the ſame in this as in the laſt problem, only inſtead of bringing 1° of ♊, as before, you now work with 1° of ♋, or rather 30 of ♊, for then the ſun enters *Cancer* on *June* 21, or longeſt day.

You will find him, therefore, riſe at *London*, *June* the 21ſt, at 42 m. paſt 3 in the morning, which wants 8 h. 18 m. of 12; this doubled gives 16 h. 36 m. for the longeſt day at *London*.

Then work with ♑ *Capricorn* for the ſhorteſt day; *viz.* bring ♑ *Capricorn* to the meridian, and the index to 12, and you will find the ſun riſes 18 m. paſt 8, which wants 3 h. 42 m. of 12; this doubled gives 8 h. 18 m. the length of the ſhorteſt day, which added to 16 h. 36 m. the longeſt day gives 24 h. for day and night.

Thus you ſee the length of the longeſt day in ſummer, is the ſame as the length of the longeſt night in winter.

Proceed now for *Stockholm* (*viz.* 59° 33' N. latitude) after the ſame manner, you will find the longeſt day to be about 18 ½ h. and the ſhorteſt 5 ½ h. And thus, for any latitude, or place, not exceeding 66 ½ d. for there the days will be 24 h. and, if you go to a greater latitude, either N. or S. you will find them 30 h. long, 2, 3, 4, or 5 days, or 2, 3, 4, or 5 weeks, or as many months, which I ſhall explain in a problem by itſelf by and by.

Tyro. This is a little ſurprizing indeed, and at preſent I muſt own myſelf a ſtranger to it.

Philo. I aſſure you it is no more ſtrange than true, and will very plainly appear ſo to you, when we come to treat of it.

* * *

PROB. XVII.

To tell the ſun's right aſcenſion.

WHAT right aſcenſion is, ſee *Dial.* VII. *Sect.* I *Article* VI.

Bring the ſun's place to the *Brazen Meridian*, and note what degree of the *Equator* is cut by the meridian, for that is his right aſcenſion required.

EXAMPLE.

I would know the ſun's right aſcenſion, on *March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt.

I find the ſun's place for theſe different days, and bringing it to the meridian, I find the meridian cuts the *Equator* in (0) in (90) in (180) and in 270°) his right aſcenſion required.

Note. When the ſun enters ♈, *March* the 21ſt, he has no right aſcenſion, becauſe it is counted from, or begins at ♈; therefore, on *March* the 20th, he muſt have his greateſt right aſcenſion; *viz.* 359°.

* * *

PROB. XVIII.

To find the ſun's oblique aſcenſion and deſcenſion at any time, and in any latitude.

See oblique aſcenſion and deſcenſion, *Dial.* VII. *Sect.* I. *Article* VII, VIII.

N. B. Though the latitude is not required in finding the right aſcenſion, becauſe the *Equator* will be cut in the ſame place by the meridian, let the pole be elevated, or depreſſed; yet in the oblique aſcenſion, the *Horizon* will cut the *Equator* in different degrees, according to the latitude, as will appear by the work and your own conſideration.

RULE.

RULE.

1. REctify the globe, and bring the ſun's place down to the eaſtern verge of the *Horizon*, then obſerve what degree the *Horizon* cuts the *Equator* in, for that is the oblique aſcenſion required.

2. Turn the globe till the ſun's place comes to, or lies level with the weſtern verge of the *Horizon*, and the degree of the *Equator* cut by the *Horizon*, is the oblique deſcenſion required.

Thus on *March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt; *viz.* when the ſun enters ♈, ♋, ♎, and ♑, you will find his oblique aſcenſion at *London*, to be (0) (56) (180) and (304.)

And on the ſame days his oblique deſcenſion will be (0) (123) (180) and (237½.)

PROB. XIX.

The latitude and day of the month given, to tell the ſun's aſcenſional difference; viz. how much he riſes, or ſets, before and after 6; and conſequently, to tell the length of the days, ſuppoſe there were no index to the globe.

RULE.

BY *Prob.* XVIII. and XIX. find the ſun's right and oblique aſcenſion; then ſubtract the oblique from the right aſcenſion, or the contrary, and the remainder is the aſcenſional difference required; which divide by 15, the degrees of the *Equator* that paſs through the meridian for 1 hour (or 7½ for ½ an hour) gives the anſwer in time that the ſun riſes and ſets before and after 6. *See an example in figures, how to convert degrees and minutes into time,* Prob. XXVI.

EXAMPLE *for* LONDON.

On *May* the 26th, I find the ſun 6 d. of ♊, and his right aſcenſion is 64 d. and on the ſame day his oblique aſcenſion is 34 d. now 34 d. from 64 d. there remains 30 d. his aſcenſional difference; which divide by 15 gives two hours, the time that he riſes before, or ſets after, 6.

This you may prove by *Prob.* XV. for you will find he riſes at 4, and ſets at 8, *May* the 26th.

But on *December* the 6th, his right aſcenſion is 256 d. and his oblique aſcenſion is 286 d. their difference is 30 d. which is two hours, that he riſes after, or ſets before 6, which is 16 d. ♐.

N. B. The right, exceeds the oblique aſcenſion from ♈ to ♎, when the ſun riſes before 6; but the other half year that he riſes after, or ſets before, 6, the oblique exceeds the right aſcenſion.

PROB. XX.

The latitude and day of the month given, to tell the ſun's amplitude; viz. *his diſtance from the E. and W. points at his riſing and ſetting; and the points of the compaſs he riſes and ſets upon.*

RULE.

THE globe being rectified, bring the ſun's place to the eaſtern verge of the *Horizon* (which ſhews his riſing) then the degrees upon the innermoſt circle of the *Horizon*, counted from the true E. point to the place where the ſun's place lies againſt on the *Horizon*, ſhews you the ſun's amplitude.

EXAMPLE *at LONDON.*

Proceed according to the rule, you will find the ſun's amplitude (*May* the 21ſt) at riſing to be about 34° from the E. to the N. and at ſetting 34° from the W. to the N. and the point he riſes upon is N. E. by E. and he ſets N. W. by W. But

W. But on *November* the 5th, he has about 25 ½ d. amplitude from the E. to the S. and at ſetting 25 ½ d. from the W. to the S. The point he riſes upon is E. S. E. and the point he ſets upon is W. S. W.

* * *

PROB. XXI.

The latitude and day given, to tell the ſun's Azimuth; *viz. his diſtance from the* E. *and* W. *or from the* N. *and* S. *points at any time.*

See Azimuth, *Dial.* VII. *Sect.* I. *Article* XI.

RULE.

RECtify the globe in general, then turn the globe till the index points to the given hour; this being done, turn the quadrant, till it touches the ſun's place for the given day; and then the quadrant will cut the *Horizon* in the *Azimuth* required from the E. or W. points, or from the N. or S. points, for you may reckon from either, only then name it properly and accordingly.

Thus on *Auguſt* the 17th, at 9 in the morning, the ſun will have about 30° *Azimuth* from the E. to the S. or, which is the ſame, 60° from the S. to the E. for 60° and 30° make 90° the whole quarter from E. to S.

N. B. Some authors call this 60 d. S. amplitude; but others call it 30 d. S. amplitude; that is, 30 d. from the E. to the S. as I ſaid before.

This will appear yet plainer, if we would know the *Azimuth* of the ſun the ſame day, at 11 in the morning; which is 68 ½ d. from the E. to the S. or 21 ½ d. from the S. to the E.

Bu on *May* the 21ſt, at 3 in the afternoon, he will have 25° *Azimuth* from the W. to the S. *viz.* 65° *Azimuth* from the S. to the W. And at ¾ paſt 5, his *Azimuth* is 10° from the W. to the N. or 80° from the N. to the W.

Tyro. Sir, I underſtand the demonſtration quite well; but how am I to expreſs or name the *Azimuth* in general?

Philo. By the words North and South, becauſe it will always be either northward, or ſouthward, reckoning from the E. and W. points, as the two ſouthwards.

Thus as before, *Auguſt* the 17th, at 9 in the morning, the ſun has 39° S. *Azimuth* (*viz.* from the E. point ſouthward) but on *May* the 21ſt, at ½ h. paſt 4 in the morning, he has 30° N. *Azimuth*; *viz.* 30° from the E. northward.

PROB. XXII.

The latitude and Azimuth *given on any day, to tell the hour, or time of the day.*

RULE.

THIS is the reverſe of the former problem; for the globe being rectified, under the quadrant of altitude to the given degree of *Azimuth*, from the E. or W. point on the *Horizon*, and there hold, or ſteady, the quadrant with one hand, and with the other turn the globe, till the ſun's place for the given day touches the figured edge of the quadrant, and the index will point to the hour, or time, required.

EXAMPLE *for* LONDON.

On *Auguſt* the 17th, I obſerved the ſun's *Azimuth* to be 30° from the E. to the S. I would know the hour. Anſwer, 9 in the morning.

Again, On *May* the 21ſt, I find his *Azimuth* 10° from the W. to the N. what is the hour? Anſwer ¾ paſt 5 in the afternoon.

PROB. XXIII.

The latitude, day, and hour given, to tell the ſun's almicanter.

DEFINITION.

ALmicanters are circles of altitude that run parallel to the *Horizon,* whoſe poles are the *Zenith* and *Nadir*; ſo that you may imagine as many circles of altitude, *viz.* almicanters, as you pleaſe.

RULE.

The almicanter is found the ſame as the altitude of the ſun at any time; therefore, I refer you back to *Prob.* XIII.

PROB. XXIV.

The latitude and length of the day given, to tell what other day of the year will be of the ſame length.

RULE.

HAVING found the ſun's place for the given day, bring it to the meridian, and obſerve well its declination; then turn the globe till ſome other degree of the ecliptic comes under the ſame degree of declination under the meridian; this being done, ſee what day of the month anſwers to the ſun's place then under the meridian, for that is the day required; which you may eaſily prove by *Prob.* XV.

I would know what day is of the ſame length as *May* the 26th, and of the ſame length as *April* the 17th. Anſwer, *July* the 23th, and *Auguſt* the 29th.

Note, Theſe laſt 8 *Problems*, as alſo *Prob.* IX. and X. are common to both globes; but are inſerted here, becauſe many perſons have a *terreſtrial*, that have not a *celeſtial globe*.

The following *Problems* more particularly concern, or belong to the *terreſtrial globe*.

* * *

PROB. XXV.

The latitude and day given, to tell the beginning, ending, and (conſequently) the length, or continuance, of twilight.

DEFINITION.

TWilight is that faint light which begins immediately after the ſun ſets in the evening, till he is 18° below the *Horizon*; and it begins in the morning, when the ſun comes within 18° of the *Horizon* on the E. ſide, and ends when he riſes. Therefore it is plain, that twilight is not only longer when days encreaſe in length; but it is alſo much ſtronger, as you will ſee preſently by the work of the *Problem.*

Tyro. I have heard that this *Problem* is very difficult to what ſome are?

Philo. It is ſomething longer in its operation, but very eaſy, if you mind the rule and the operation together.

OBSER-

OBSERVATION.

As you were told that twilight begins and ends when the ſun is 18 below the *Horizon*, and as the quadrant of altitude reaches no longer than the *Horizon*, therefore the rule is this.

RULE.

The globe being rectified, *&c.* bring the oppoſite degree of the ſun's place to the quadrant of altitude, ſo that it touches juſt 18 on the quadrant (then it is plain that the ſun's real place will be depreſſed 18 below the *Horizon)* then look on the index, for that will point (if among the morning hours) to the beginnnig, or (if among the evening hours) ending of twilight.

Note 1. What I mean by the oppoſite place of the ſun is this; it is that degree of the ecliptic oppoſite to, or 180 d. from the given place of the ſun. Thus, ſuppoſe the ſun was in ♈, then I bring its oppoſite ſign (*viz.* ♎) to 18 d. on the quadrant, ſo will ♈ be depreſſed 18 d. and the index will ſhew the hour.

Tyro. Sir, I now underſtand it very clearly.

Philo. Proceed then according to the rule, and you will find that on *March* the 21ſt, and *September* the 22d, twilight begins about 4 in the morning, and ends about 8 at night.

The ſun on theſe days you know riſes and ſets at 6. Add, therefore, the length of morning and evening twilight to 12 hours (the length of the days then) and it gives 16 hours, this ſubtracted from 24 hours, leaves 8 hours, the length of the real, or dark, night.

So alſo on *April* the 24th, twilight begins about ½ paſt 2, ends about ½ paſt 9, which is in all 7 hours. But on *December* the 20th, it begins at 6, and ends at 6, which is in all but 3 h. 40 m.

Note 2. There is no real night at *London* (but twilight) from *May* the 22d, to *July* the 20th, the ſun all that time being leſs then 18 d. below the *Horizon*.

PROB.

PROB. XXVI.

The hour given, where you are to tell what hour it is in any other part of the world. See *Prob.* VI.

RULE.

BRING the given place to the meridian, and ſet the index at the given hour; then turn the globe till the other place, or places, come under the meridian, and the index will point to the real time in the place required.

EXAMPLE.

When it is 2 o'clock in the afternoon, at *London*, I would know the time at *Jeruſalem*, and at *Port Royal* in *Jamaica?*

Proceed according to the rule, and you will find, that when it is 2 in the afternoon at *London*, it is 25 minutes paſt 4 at *Jeruſalem*; and but 52 minutes paſt 8 in the morning at *Port-Royal*.

Another

Another METHOD.

I told you in *Problem* VI. that 15° on the *Equator* make 1 hour of time; therefore this *Problem* may be anſwered by common diviſion, for having the difference of the longitude of any two places (taken from a map) divide it by 15, the quotient is the difference of hours; and, if any degrees remain, allow 4 m. for every degree, and ſo in proportion for the minutes or miles.

Thus I find by *Problem* VI. *Jeruſalem* is 36° 15′ E. longitude of *London*; I divide, therefore, 36° 15′ by 15, and the quotient is 2 hours, and the remainder is 6, which is 6 times 4, or 24 m. and the odd 15 m. or miles, is 1 m. ſo that the difference is 2 hours 25 m. and as *Jeruſalem* is E. of *London*, it has its hour before us, therefore it is 25 m. after 4 in the afternoon.

Again, *Port Royal* is 77 5′ W. of *London*; this converted into time as before is 5 h. 8m. that *Port Royal* has its time later than *London*; for when it is noon at *London*,

don, it wants 8 m. of 7 in the morning at *Port Royal*, &c. &c.

PROB. XXVII.

The day of the month given, to tell thoſe inhabitants that will have the ſun in their Zenith *(or over their heads) on that day.*

OBSERVATION.

THIS cannot happen to any other inhabitants, but in the *Torrid Zones*, that is, to all ſuch as have not above 23½d. of latitude, either N. or S.

RULE.

Bring the ſun's place to the meridian, and obſerve exactly his declination for that day; then turn the globe any way, and obſerve what places paſs under that degree of declination on the meridian; for all ſuch will have the ſun right over their heads ſome time or other on that day.

EXAMPLE.

I would know what inhabitants, or places, will have the ſun in their *Zenith* on *May* the 21ſt.

Proceed as directed by the rule, you will find *St. Jago* in *Hiſpaniola*, *St. Jago* in *Cuba*, *Campeachy*, and many other places that will paſs under that degree of declination *(viz.* 20° N.) and will have the ſun in their *Zenith* that day.

Alſo on *April* the 16th, the inhabitants of *Porto-Bello*, the *Oroonoko* iſlands, *Bay of Siam*, *Iſle of Ceylon*, and the *Philippine* iſlands, will have the ſun that day in, or near, their *Zenith*.

PROB.

PROB. XXVIII.

The day and hour given in any place, to tell thoſe inhabitants, or that place, to which the ſun is then vertical; viz. *in the* Zenith.

RULE.

BRING the given place to the *Brazen Meridian*, and turn the index to the given hour; this done, turn the globe till the index points to the upper 12, or noon; then look under the degree of declination on the globe for that day, for that is the very ſpot, or place, to which the ſun is then vertical.

EXAMPLE.

On *May* the 13th, at 8 m. paſt 5 in the afternoon, at *London*, I would know what place has the ſun then in their *Zenith*. Anſwer. *Port Royal.*

N. B. There are two days in which the ſun is vertical to all the inhabitants in the *Torrid Zones*; which muſt be when the ſun has the ſame declination, and in this *Problem* will be *July* the 27th; *viz.* the ſame declination as on *May* the 13th.

Thus alſo you will find when it is 33 m. paſt 6 in the morning at *London*, on *April* the 12th, and *Auguſt* the 28th, the inhabitants at *Candy* in the *Iſland of Ceylon*, will have the ſun then in their *Zenith*.

* * *

PROB. XXIX.

To tell the diſtance from one place to another in degrees and minutes (viz. *miles*) *in an arch of a great circle,** *alſo their bearing, or ſituation, in reſpect of each other.*

RULE.

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* *Note.* Sixty miles, or minutes, are reckoned a degree in general; but this is a vulgar error; for it is proved that every degree on the earth's ſurface in every great circle (ſuch as the *Equator*, *Meridian*, &c.) is 69½ miles; therefore multiply the degrees by 69½, you have the diſtance in *Engliſh* miles.

RULE.

BRING one of the places to the meridian, and elevate the globe for the latitude of it, and fix the quadrant in the *Zenith:* then turn the globe till the quadrant touches the other place, and the degrees on the quadrant between place and place ſhews the diſtance; and the quadrant at the ſame time will cut the *Horizon* in the point of the compaſs, called the bearing, or ſituation, from the firſt place.

EXAMPLE.

I would know the diſtance from *London* to *Port Royal*, *Jeruſalem*, and *Moſcow*, as alſo their ſituation in reſpect of *London*?

Proceed according to the rule, and you will find that from *London*

	Deg.		Miles.
To *Port Royal*	68½	*viz.* nearly	4760¾ W.
To *Jeruſalem*	33½		2311 E. S. E.
To *Moſcow*	23		1598½ E. N. E.

PROB. XXX.

The latitude and day given, to tell what time the ſun will be due E. or W.

Tyro. THIS is eaſy I think; for as the ſun is always due N. and S. at 12 at night, and at 12 at noon, I ſuppoſe he will be due E. and W. at 6 in the morning, and 6 in the evening.

Philo. I thought you would ſtumble upon this general error; but you will ſoon ſee your miſtake.

RULE.

Rectify the globe and quadrant as before directed: then turn the quadrant till it touches the E. or W. point of the *Horizon*; this done, turn the globe till the ſun's place for the given day comes to the edge of the quadrant (holding the quadrant to the E. or W. point) ſo will the index point to the hour of his being due E. or W. on that day.

Proceed thus, and you will find about 5 m. paſt 7 in the morning, on *May* the 21ſt at *London*, the ſun will be due E. and about 5 m. before 5 in the evening due W. On *June* the 21ſt, he will be due E. about 22 m. paſt 7 in the morning, *&c.* but on *December* the 21ſt, he is due E. about 45 m. paſt 4 in the morning, and due W. about 35 m. paſt 7 in the evening.

* * *

PROB. XXXI.

To tell how many degrees of the Equator (viz. *how many miles) are contained in any parallel of latitude. Or, to find how many miles are contained in a degree of longitude in any latitude.*

RULE.

1. FIX the quadrant in the parallel, and obſerve how far 10, 15, or any other number in that parallel

will reach on the quadrant. Or thus, take off 10, 15, or any other number of degrees in the parallel given, with a pair of good dividers, and apply that diſtance on the *Equator*, and obſerve how many degrees the ſame opening of the compaſſes cut on the *Equator*, for ſuch is the proportion: therefore,

2. Bring the degrees that the dividers cut on the *Equator* into miles (which in this problem is cuſtomary to count 60° to a mile, becauſe it in ſome meaſure relates to navigation) and divide that product by the number of degrees in the parallel, be it 10, 15, *&c.* and the quotient gives the anſwer.

EXAMPLE.

I would know how many miles (allowing 60 to a degree) are contained in the parallel of latitude 52?

I take 10 d. in the parallel of latitude 52, and apply that diſtance to the *Equator*, and find it cuts $6\frac{1}{6}$; *viz.* 6 d. 10 m. or, I take 15 on the parallel, and find it cuts $9\frac{1}{4}$, or 9 d. 15 m. Then I multiply 6 $\frac{1}{6}$ by 60, and divide by 10, it gives 73; or I multiply 9 $\frac{1}{4}$ by 60, and divide by 15 (that I took off) in the parallel, and it alſo gives 37 miles, which are contained in 1 d. in parallel of latitude 52.

Proceed after the ſame manner by taking off 10, 15, *&c.* degrees in any parallel, and apply it to the *Equator*, you will have the miles in that parallel, according to this *Problem*; viz. 60 to a degree. Thus you find that in the

			Miles.
Latitude	15	there contains about	58 to 1 d.
	30		51 56m.
	45		42 44
	60		30
	75		15 32
	90		00

PROB.

PROB. XXXII.

To find the Antæci *to any place.*

See *Antæcians*, Dialogue VI. Sect. IV. Article I.

RULE.

BRING *London* (or the given place) to the meridian, and count from the *Equator* on the meridian ſouthward the ſame number of degrees of S. latitude, as *London* has N. (*viz.* 51° 32′) and cloſe to the edge of the meridian make a dot, for that place is the *Antæci* to *London*.

* * *

PROB. XXXIII.

To find the Periæci *to* London, *or any other place.*

See definition of Periæcians, *Dial.* VI. *Sect.* IV. *Article* II.

RULE.

BRING *London* to the meridian, and turn the globe till 180° of the *Equator*

Equator paſs from *London* under the meridian; then under the ſame latitude as *London* (viz. under 51 ° 32 ′ N. at the edge of the *Brazen Meridian)* make a dot, for that is the place of the *Periæcians* required.

PROB. XXXIV.

To find the Antipodes *to* London, *or any other place.*

See definition of Antipodes, *Dial.* VI. *Sect.* IV. *Article* III.

RULE I.

BRING *London* to the meridian, then the degree in the *Nadir* (viz. 38 ½ d. from the S. pole) is the place of the *Antipodes* to *London.*

OR II.

Bring *London* to the meridian, and turn the globe till 180 ° paſs thro' the meridian,

dian, then count 51° 32′ ſouthward on the meridian, and under it make a dot, for that is the *Antipodes*.

Or rather thus:

Bring *London* to the meridian, then ſlip the globe in the notches of the *Horizon*; viz. depreſs the pole, till *London* lies at the N. verge of the *Horizon*, juſt at the edge of the meridian; then at the S. point of the *Horizon*, cloſe to the meridian, make a dot, for that is the place of the *Antipodes* of *London*, which you will find to be in the *Great South Sea* 51° 32′ S. latitude, 180° longitude.

Thus alſo the *Antipodes* to *Cape Antonia* in *South America*, is the bay of *Nankin* in *China*. And the *Antipodes* to *Barbadoes*, is a little ſhoal in the ſtreights of *Sapy*.

N. B. By bringing two places thus to the *Horizon*, which are *Antipodes*, you may in a great meaſure judge of the cauſe of eclipſes; for the places are diametrically oppoſite to each other, and you may imagine the ſun to be one place, and the moon another.

PROB.

PROB. XXXV.

The longeſt day in any latitude given (ſuppoſing London *16 ½ hours) to tell in what other latitude the longeſt day is 1, 2, 3, &c. hours longer than in the given place.*

RULE.

RECtify the globe for the given latitude (viz. *London)* and bring the ſolſticial colure *(viz.* ♋) to the meridian; then where the *Horizon* cuts the tropic of ♋, make a dot on the tropic at the verge of the *Horizon:* this done, turn the globe weſtward, till 7 ½ d. of the *Equator* paſs under the meridian, and then make a ſecond dot on the tropick againſt the *Horizon* as before; then turn the globe back to its firſt poſition *(viz.* to ♋) and then elevate the pole, till the ſecond dot appears at the edge of the *Horizon*, and the *Horizon* at the ſame time will cut the meridian in the latitude required.

Proceed as above, and you will find that in the latitude 56° 20′, the days are 1 hour longer than at *London*, which you may eaſily prove by *Prob.* XVI.

2. If you want to know the latitude where the day is 2 hours longer than at *London*, then proceed as before, only inſtead of cauſing 7 ½ d. to paſs under the meridian, you muſt now turn the globe till 15° paſs under the meridian, and make then a ſecond dot on the tropic.

3. If you want for 3 hours longer, make 22 ½ d. paſs through the meridian, and proceed as before; and thus for every hour, cauſe 7 ½ d. more to paſs under the meridian.

Note. If you want to know the latitude where the longeſt day is an hour ſhorter than at *London*, only turn the globe eaſtward inſtead of weſtward, till 7 ½ d. paſs thro' the meridian, and make a prick on the tropic, and depreſs the pole till this lies even with the *Horizon*, you will find the latitude about 45 ½ d. Thus for two hours longer about 60°, for 4 hours about 64° 20′; but for 2 hours ſhorter the latitude is about 35 ½ d. This problem ſhews you the difference of climates.

* * *

PROB. XXXVI.

Any time not exceeding 6 months given, to tell that latitude, or thoſe places, where the ſun will not ſet for all that time.

Note, That 28 days are here reckoned to the month. Bring the given time into days, and take the ½ of the number of the days; but remember to abate 1. If the ½ exceeds 30, then count from *Cancer* on the ecliptic the ſame number of degrees as the ½ amounted to, and where this reckoning ends make a dot on the ecliptic. *Laſtly*, Bring this dot to the meridian, and as many degrees as are intercepted, or lie between the dot and the pole itſelf, counted on the meridian, is the latitude required.

EXAMPLE.

I Demand the place or latitude, where the ſun does not ſet for the ſpace of 4 months 16 days?

This is 128 days, the ½ is 64°, abate 1° is 63°; this I count from ♋ on the ecliptic, and make a dot, and bringing it to the meridian, I find there are nearly 80° between the dot and the pole; *viz.* the latitude is 80°. which is at *Smith's Inlet*, the upper part of *Greenland.*

So alſo in the latitude of 85°, he ſets not for 5 months 2 weeks. And in the latitude of 86½d. for 5 months, 3 weeks, and 3 days; and in the latitude 90, not for 6 months; *viz.* from *March* the 21ſt, to *September* the 22d.

Tyro. This appears now very plain to me, but I know the generality of perſons believe it to be falſe, for want of conderation.

Philo. You ſee it is evident, for under the pole, in the latitude 90, when the ſun enters ♈, he begins to riſe, and ſets not with them till he enters ♎; *viz.* for 6 months.

Tyro. I ſee it, Sir, quite evident; but, pray, have they not alſo a great ſhare of twilight? And are not the inhabitants at the contrary pole in darkneſs for a long time?

Philo. Yes, and ſo are the inhabitants in the N. part, when the ſun is in the tropic of ♑. This is plainly demonſtrated by the next *Problem.*

PROB. XXXVII.

To tell in the latitude 90 (where the longeſt day is 6 months) how long it continues to be twilight after ſun-ſet; and how long their night is, after twilight ends, before it begins again.

RULE.

YOU remember according to the laſt *Problem,* the ſun ſets with the inhabitants at the N. pole, and riſes to thoſe of the S. pole, on *September* the 22d: therefore twilight begins with them at the N. pole on *September* the 22d. Therefore,

RULE.

1. Elevate the pole to the *Zenith*, and turn the globe, till ſome degree of the ſun's place in the ecliptic lies under 18° of the meridian, under the S. part of the *Horizon*, and you will find it 24° ♍; *viz. November* the 14th, the ending of twilight, that is, they have twilight from *September* the 22d, to *November* the 14th, and then they begin to have dark nights (ſave the advantage of the moon) till the 24th of *January*. For,

2. Turn the globe till ſome other point of the ecliptic comes under 18° as before, and you will find it about 5° of ♒, which anſwers to the 24th of *January*, the beginning of twilight to the inhabitants at the N. pole, and then on *March* the 21ſt, he riſes with them.

Thus it appears, that the length of their day (from ſun-riſing to ſun-ſetting) is from *March* the 21ſt, to *September* the 21ſt. The length, or continuance, of twilight, is from *September* the 21ſt, to *November* the 14th, and from *January* the 24th, to *March* the 21ſt, in all about 110 days, and their real night is from *November* the 14th, to *January* the 24th; *viz.* about 71 days.

Note, The ſame holds good to the ſouthern inhabitants at the S. pole, for he riſes with them when he enters ♎, and ſets with them when he comes to ♈, *&c.*

Tyro. I perceive it plainly, Sir; and thank you for this plain demonſtration.

Phio. Now, *Tyro*, I ſhall ſhew you the uſe of the *celeſtial globe*; and after that ſet you ſome *Problems*, with the practical uſe of both.

Here follows ſome *Problems* on the *celeſtial globe*.

PROB. XXXVIII.

The day of the month given, to find the ſun's place in the ecliptic.

See *Problem* VII.

PROB. XXXIX.

This is the reverſe of the laſt, and done the ſame as *Prob.* VIII.

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PROB. XL.

To find, or tell, the declination of the ſun on any day of the year.

The ſame as *Problem* X.

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PROB. XLI.

To find the ſun's right aſcenſion.

See *Prob.* XVII.

* * *

PROB. XLII.

To tell the ſun's oblique aſcenſion and deſcenſion in any latitude, and on any day.

The ſame as *Prob.* XVIII.

PROB. XLIII.

The latitude and day given, to find the ſun's aſcenſional difference.

The ſame as *Prob.* XIX.

* * *

PROB. XLIV.

The latitude and day of the month given, to tell the ſun's amplitude; viz. *his diſtance from the E. and W. points at riſing and ſetting.*

The ſame as *Prob.* XX.

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PROB. XLV.

The latitude and day given, to tell the ſun's Azimuth

The ſame as *Prob.* XXI.

PROB. XLVI.

The latitude and Azimuth *given, to tell the day, ſuppoſing it were loſt.*

See the rule, *Prob.* XXII.

* * *

PROB. XLVII.

The latitude, day, and hour given, to tell the ſun's almicanter.

See the rule, *Prob.* XXIII.

* * *

PROB. XLVIII.

To find the right aſcenſion of any ſtar.

RULE.

BRING the center of the ſtar to the meridian, and the degree of the equinoctial,

noctial, cut by the *Meridian*, is the right aſcenſion required.

Thus you will find the right aſcenſion of *Aldebaran* in *Taurus*, to be about 65°, *Arcturus* in *Bootes*, about 210° 45′, *Regel* in *Orion*, about 75° 30′, and *Sirius*, or the *Dog-ſtar*, about 98 d. *&c.* *&c.*

* * *

PROB. XLIX.

The latitude given, to tell the oblique aſcenſion and deſcenſion of any ſtar.

RULE.

RECTIFY the globe, and bring the ſtar down to the eaſtern verge of the *Horizon*, and the degree of the equinoctial, that is then cut by the *Horizon*, is the *oblique* aſcenſion required. Turn the ſtar to the weſtern ſide, and the degree of the equinoctial, cut by the *Horizon*, is the ſtar's *oblique* deſcenſion.

Proceed thus, and you will find the *oblique* aſcenſion of *Regel* to be about 86° 30′, of *Marhal* in *Pegaſus*, about 325°, and of *Aldebaran*, or *Bull's Eye*, about 43° 30′. Turn each of theſe to the weſtern ſide, you will find their *oblique* deſcenſion 54°, 360° nearly, and 87 degrees.

Note. There is this difference between the right and oblique aſcenſion and decenſion of the ſun and ſtars. For the ſun's oblique aſcenſion, &c. differ every day in the ſame latitude, but the ſtars oblique aſcenſion is every day the ſame.

* * *

PROB. L.

To tell the declination of the ſtars.

RULE.

As for the ſun's place, ſo alſo here, bring the given ſtar to the *Brazen Meridian*, and obſerve what degree of the *Meridian* lies right over the center of the ſtar, for that is the declination either N. or

N. or S. according to which ſide of the equinoctial it lies on.

Thus you will find the declination of *Aldebaran* to be about 16° 45′ N. The upper pointer to the pole (in *Urſa Major*) about 63 ½ d. and the lower one nearly 58 ½ d. but *Regel* in *Orion* I find about 8 ½ d. S. and *Cor Scorpio* about 26 d. S. declination, *&c. &c.*

From this *Problem* and the XLVIIIth, ariſeth

* * *

PROB. LI.

The right aſcenſion and declination of any ſtar given, to find the ſame at once.

BRING the given degree of *right* aſcenſion on the equator to the *Brazen Meridian*, then look under the degree of declination on the *Meridian*, and you will find the ſtar at the *Meridian*, under the given degree of declination.

Thus, ſuppoſe I wanted to find *Aldebaran*, whoſe right aſcenſion is 65°, and his declination 16° 45′ N. I firſt bring 65° of the equinoctial to the *Meridian*; and looking under 16° 45′ N. declination on the *Meridian*, I find *Aldebaran*.

So alſo *Sirius* has 98° *right* aſcenſion, and 16° 50′ S. declination; therefore I bring 98 d. of the equinoctial to the *Meridian*, and looking under 16° 30′ S. declination on the *Meridian*, I find *Sirius* juſt at the *Meridian*. The ſame for any other ſtar.

PROB. LII.

To tell the riſing and ſetting of the ſtars, and the point of the compaſs any ſtar riſes or ſets upon in any latitude, and on any day of the year.

RULE.

RECTIFY the globe, and bring the ſun's place to the *Meridian*; then turn the globe till the given ſtar comes to the eaſtern verge of the *Horizon*, and the index will point to the time of riſing, and the *Horizon* will ſhew the point it riſes upon: turn it to the Weſt, and the index will point to the time of ſetting, and the *Horizon* will ſhew you the point it ſets upon.

Proceed thus, and you will find that *Aldebaran*, on *November* the 5th, at *London*, riſes a little paſt 6 in the evening, and ſets about 9 in the morning. The point he riſes upon is E. N. E. and the point he ſets upon is W. N. W. But *Regel* in *Orion*, the ſame night, riſes a little before 9 at night, and ſets about ½ paſt 7 in the morning. The points of riſing are W. by S. and ſetting E. by S.

Note, The ſtars riſe and ſet every day on the ſame point of the compaſs, though at contrary hours.

PROB. LIV.

To tell the time; Viz. how many hours any ſtar continues above the Horizon, *from its riſing to its ſetting, in any latitude.*

RULE.

RECtify the globe, then bring the ſtar to the eaſtern verge, and note the time of riſing, then turn the globe to the weſtern ſide; and the number of hours that paſſed through the dial-plate tells you the continuance of that ſtar above the *Horizon*.

Thus, I find *Aldebaran* at *London* continues up from the time of his riſing on any day (but for example take *December* the 25th) about 15 hours; and *Regel* about 10½ hours.

At *Stockholm*, *Aldebaran* continues up above 16 hours; but at *Port-Royal* he continues up but about 12¾ hours.

PROB. LIV.

To tell the diſtance of one ſtar from another in degrees and minutes, in the arch of a great circle.

TO this *Problem are three variations;* 1. If the ſtars lie under the ſame *Meridian,* bring them to the *Brazen Meridian,* and the degrees intercepted between them, counted on the *Meridian,* is the diſtance required.

Thus, I find the two pointers in the *Great Bear* to be about 5 ½ d. diſtant from each other; and *Eridef* and the *Dolphin's Eye* about 29 ½ d. diſtant.

2. If they lie under the ſame declination, bring the firſt (at pleaſure) to the *Brazen Meridian,* and note the degrees cut by the *Equator;* then bring the other to the *Meridian,* and note how many degrees difference have paſſed through the *Meridian,* for that is their diſtance required.

Thus, I find, the difference between *Aſſengue* and *Caput Meduſæ* to be about

122 ½ d. for *Aſſengue* (38 ½ declination) being brought to the *Meridian*, cuts 277° 30′ *viz.* 82° 30′ from ♈ weſtward; and *Caput Meduſæ* cuts 40 of the *Equator* eaſtward; their diſtance, therefore, is 122° 30′.

3. If neither of the ſtars lie under the ſame degree of the *Meridian*, or declination, then bring either of them to the *Meridian*, and elevate the pole to the ſame height as the ſtar has declination (that is, the ſame as you elevate the terreſtrial globe to the latitude of a place) for then the ſtar will be in the zenith: therefore, fix the quadrant to the zenith, over the center of the given ſtar, and extend it to the other ſtar, and the degrees on the quadrant is the diſtance required in a true arch of a great circle.

Note. Though the diſtance of the ſtars from each other are thus determined in degrees, yet you are not to ſuppoſe their Diſtance is ſo many degrees to be converted into *Engliſh* miles; but it only means, that they appear ſo far diſtant under ſuch an angle.

Thus, I find the diſtance between *Capella* and *Cor Hydra* to be about 79 d. and between *Aldebaran* and *Sirius* about 46° 30′ &c.

4. If the ſtars be ſuch a diſtance from each other, that the quadrant will not reach them, then bring either of them to the *Horizon*, and elevate, or depreſs the pole, till the other lies alſo at the verge of the *Horizon*, and the degrees counted upon the *Horizon*, between ſtar and ſtar, is their diſtance in degrees.

Thus, between *Aldebaran* and *Cor Scorpio* you will find about 170 degrees.

PROB. LV.

To tell what ſtars will be on, or near the Meridian, at noon and at midnight.

First, for thoſe at noon.

BRING the ſun's place to the *Meridian* for the given day, and all thoſe ſtars that are then under the *Meridian*, are ſuch as are full S. at noon.

2. Turn the globe till the index points to 12 at night (*viz.* the lower 12) and all

those ſtars that are then under the *Meridian* are the ſtars required.

Thus, I find, on *May* the 27th, *Aldebaran* is on the *Meridian* at noon, and *Cor Hydra* will be on the *Meridian*, *Auguſt* the 7th at noon; but on *February* the 3d, *Cor Hydra* will be full S. about night. For only turn *Cor Hydra* under the *Meridian*, and the index will point to the lower 12; and the *Meridian* itſelf will cut the ecliptic in 15 d. of ♒; *viz. February* the 3d.

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PROB. LVI.

The latitude, day of the month, and heighth of any ſtar given, to tell the time or hour of the night.

RULE.

RECTIFY the globe for the latitude, *&c. &c.* then fix the quadrant in the zenith, and move the globe and the quadrant together, till the ſtar cuts the quadrant in the given heighth; and the index will point to the hour.

EXAMPLE.

On *January* the 21ſt (at *London*) in the evening I obſerved *Aldebaran* E. S. E. to be about 40 d. high; I demand the time of this obſervation? *Anſ.* A little paſt 5 in the evening. Again, on *December* the 25th, in the evening, I obſerved *Sirius* to be about 15 d. high, and at the ſame time *Regel* to be about 28 ½ d. high; I demand the hour? *Anſ.* About 10 at night; and *Aldebaran* is under the *Meridian* at the ſame time.

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PROB. LVII.

To tell what ſtars never riſe, and thoſe that never ſet at London.

RULE.

1. ONLY obſerve what ſtars have above 38 ½ d. N. declination;

for all ſuch never ſet at *London*, but are always above the *Horizon*.

2. Obſerve alſo thoſe ſtars that have above 38 ½ d. S. declination, for thoſe never riſe, but are always under the *Horizon* at *London*.

Thus, the pointers in the *Great Bear*, *Aridef* in *Cygnus*, and many others, never ſet.

Alſo, *Canobus* in *Argo Navis*, and *Pes Centaurus*, and many others, never riſe at *London*.

OBSERVATION.

1. From what you have been taught, *Tyro*, it is eaſy to conceive, that to the inhabitants under the North pole no South ſtar can ever be ſeen, nor can the inhabitants at the South pole ever ſee one of the ſtars in the other hemiſphere. But,

2. The inhabitants under the *Equator* have a pleaſant ſight of all the ſtars from pole to pole; for they riſe and ſet with them at right angles; therefore no ſtar can continue above 12 hours above this *Horizon*.

Tyro. Sir, you have highly obliged me, and I ſee now very plainly the different aſpect of the heavens in different places.

PROB.

PROB. LVIII.

To know at any time of the year (in the latitude of London) *where to find any ſtar, or tell the name of any ſtar when required.*

RULE.

RECTIFY the globe for the day, and turn it till the index points to the given hour; then by a quadrant take the heighth of the required ſtar; or, for want of which (in a common way of gueſſing) obſerve what part of the heavens it is in; *viz.* whether E. N. E. S. W. or the like, as alſo its heighth as near as you can gueſs: this being done, ſet the globe in due order for the day and hour, and you will find the ſame ſtar on the globe; and, by applying the quadrant, you will find the exact point of the compaſs, and the real heighth the ſtar then has, which, tho' not perhaps near to what you gueſſed it at, yet, if it be any noted ſtar, you may aſſure yourſelf you are right, as there is no other ſtar of note near it about that heighth, and upon the ſame point.

EXAMPLE.

Walking on *December* 25, at 8 at night, I obſerved a bright ſtar (as near as I can gueſs) on the S. E. point, and about 48 d. high; I would know what ſtar it is? *Anſ. Aldebaran.* I rectify the globe, and turn the index to the hour, and then turn the quadrant to the given point of the compaſs, and looking about 48 d. high on the quadrant, I find *Aldebaran* to be the neareſt bright ſtar by the quadrant on that point and heighth; therefore, I conclude it is *Aldebaran*.

Alſo at ¼ paſt 10, the ſame night, I ſee two very bright ſtars, one on, or near the *Meridian*, about 30 ° high, and the other near the S. E. point, and about 35 ° high, I demand their names. *Anſ. Regel* and *Procyon* in *Canicula*.

PROB. LIX.

To tell the latitude and longitude of the ſtars.

FIRST, obſerve, whether the given ſtar be on the N. or S. ſide of the ecliptic; for if it be on the N. ſide, elevate the N. pole 66 ½ d. and turn the globe till ♋ and ♑ lie in the N. and S. points of the *Horizon*; *viz.* the ecliptic will be parallel, or even to the *Horizon*, and fix the quadrant in the *Zenith*: then keeping the globe ſteady, turn the quadrant till the edge of it touches the center of the ſtar, and that degree on the quadrant (*viz.* the altitude of the ſtar in the latitude 66 ½ d.) is the latitude required, and the degree of the ecliptic, cut by the quadrant, reckoned from *Aries* (or rather reckoned among the ſigns, as it happens) is the longitude required.

Thus you will find *Arcturus* in *Bootes* to be about 30 ½ d. N. latitude, and 203° longitude from ♑, or rather 23 d. of ♎. Alſo, *Alcair* is about 29 ½ d. of N. latitude, and 28 d. of longitude in ♑.

2. For any South Star.

Elevate the S. pole 66 ½ d. and fix the quadrant in the zenith, and apply it to the ſtar, as before directed, you have the latitude and longitude required. Thus you will find *Pes Centaurus* to have about 42 ½ d. of S. latitude, and 236 d. longitude from ♈, or rather 26 d. in ♍; and thus for any other ſtar. See *Table* III. *Dial.* VII.

PROB. LX.

The latitude and day of the month given (ſuppoſe December 25, *at nine at night at* London) *to ſet the globe ſo as to repreſent the face of the heavens at that time, and ſhew your acquaintance the name and poſition of the moſt eminent fixed ſtars.*

RULE.

RECTIFY the globe for the latitude, and bring the ſun's place to the *Meridian.*

ridian, and the index to 12. Then turn the globe to the given hour; *viz.* 5 minutes paſt 9 at night and there fix it, ſo will every ſtar on the globe (if you ſet the globe N. and S.) correſpond with, or point to, the ſame ſtar in the Heavens.

Thus (at *London*) I find *Capella* E. by S. about 75 d. high, *Caſtor* and *Pollux*, one about 40, and the other about 45 d. high; near the E. point. *Procyon* below them, to the left hand, 23 d. high E. S. E. *Sirius* yet lower, to the left, S. E. about 10 d. high; *Betelgeuze* higher, on the ſame point, and about 38 d. high; *Regel*, more ſouthward, about 26 d. high; *Aldebaran*, on the ſame point, much higher; *viz.* about 53 d. the *Seven Stars*, or *Pleiades*, S. nearly about 62 d. high; *Menear*, S. by W. 40 d. high; *Aridef* N. W. about 26 d. high, *&c. &c. &c.*

PROB. LXI.

To tell the time of the acronical *riſing and ſetting of any ſtar.*

DEFINITION.

1. THE *acronical* riſing of a ſtar is when the ſtar riſes juſt at the ſun-ſet.

2. A ſtar is ſaid to ſet *acronically*, when it ſets with the ſun.

RULE.

Bring the ſun's place for the given day, to the weſtern ſide of the *Horizon*, and all thoſe ſtars that are on, or near, the eaſtern ſide of the *Horizon*, riſe *acronically*; and thoſe on the weſtern verge of the *Horizon* ſet *acronically*.

Thus I find on *December* the 6th, that *Aldebaran* riſes *acronically*, but it ſets *acronically* on *May* the 21ſt. Alſo *Sirius* riſes *acronically* on *February* the 4th, and ſets *acronically* on *May* the 14th.

PROB.

PROB. LXII.

To tell the coſmical *riſing and ſetting of the ſtars in any latitude.*

DEFINITION.

1. A Star is ſaid to riſe *coſmically*, when it riſes with the ſun.

2. A ſtar is ſaid to ſet *coſmically*, when it ſets at ſun-riſing.

RULE.

Rectify the globe, *&c.* and bring the ſun's place to the eaſtern ſide of the *Horizon* for the given day; then all thoſe ſtars cut by the eaſtern verge of the *Horizon*, riſe *coſmically*. The globe ſtill remaining in the ſame poſition, look at the weſtern verge, or edge, of the *Horizon*, and all thoſe ſtars cut by it, or that are very near it, ſet on that day *coſmically.*

Thus I find that *Arcturus*, and 2 ſmall ſtars in *Hercules*'s thigh, riſe *coſmically*, *September* the 25th. Alſo 2 ſtars in

Eridanus, *Aſſengue* in *Lyra*, &c. &c. ſet *coſmically*. *Marhal* in *Pegaſus*, is but juſt below the *Horizon*, therefore may be ſaid to ſet nearly *coſmical*, as it will within a day or two.

For the *coſmical* ſetting,

Turn the globe till the ſtar comes to the weſtern ſide of the *Horizon*, and obſerve the degrees of the ecliptic, then cut by the eaſtern ſide of the *Horizon*, for that will anſwer to the day of the *coſmical* ſetting.

Thus *Arcturus* ſets *coſmically*, *June* the 22d. Alſo *Aldebaran* ſets *coſmically*, *December* the 20th.

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PROB. LXIII.

To tell the heliacal *riſing, or ſetting, of the ſtars.*

DEFINITION.

1. HELIACAL riſing, is when a ſtar once in the ſun's beams gets

out of them, ſo as to be ſeen at the eaſtern verge of the *Horizon*, juſt before ſun-riſing.

2. *Heliacal* ſetting, is when a ſtar once out of the ſun's beams gets into them, ſo as to be ſeen ſetting on the weſtern ſide of the *Horizon*, juſt after ſun-ſet.

Note 1. This *heliacal* riſing and ſetting of the ſtars is different, according to their different magnitudes. For,

Note 2. Stars of the firſt magnitude are ſeen at riſing and ſetting, when the ſun is but 12° below the *Horizon*. Stars of the 2d magnitude are not perfectly ſeen, till the ſun is 13° below the *Horizon*. Thoſe of the 3d degree, when he is 14°. Thoſe of the 4th degree of magnitude, when he is 15° below the *Horizon*. Thoſe of the 5th degree, when he is 16°. Thoſe of the 6th degree, when he is 17°; and the *nebulous*, or ſmall ones, not till he is 18° below the *Horizon*; viz. about the beginning and ending of twilight.

RULE.

To find the *heliacal* riſing, or ſetting, the rule is, rectify the globe, and bring the given ſtar to the eaſtern verge of the *Horizon*; then fix the globe, and turn the quadrant to the weſtern ſide, till 12° of the quadrant touches the ecliptic; this done, note the degree of the ecliptic, that is cut by 12° of the quadrant on the weſtern ſide (for then will the real place of the ſun be depreſſed 12° on the eaſtern ſide) for that degree ſought in the calender gives the *heliacal* riſing. The ſame is to be obſerved with the quadrant on the eaſtern ſide for the *heliacal* ſetting. Thus you will find *Aldebaran* riſes *heliacally*, *July* the 4th, ſets *heliacally*, *May* the 5th.

And *Sirius* the *Dog Star* riſes *heliacally*, about *Auguſt* the 26th. *

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* *N. B.* The poets, and others formerly, uſed to reckon their *Dies Caniculares* or *Dog Days*, from the *heliacal* riſing of *Sirius*; but they did not agree when they ended. Some reckoned them to continue 30, or 40, and others 50 days. However, in this they agreed, that the weather at any time was very ſultry and faint for 5, or 6 weeks after the riſing of *Sirius*. But (as it was then, ſo now)

And now, *Tyro*, I will leave you one queſtion for practice at your leiſure, in order to exerciſe you in the foregoing *Problems*.

* * *

PROB. LXIV.

The latitude and day given (ſuppoſe at London, November *the 5th) to tell,*

1. THE *riſing and ſetting of the ſun, and the point he riſes and ſets upon.*
2. *His meridian altitude.*
3. *His altitude at any hour, ſuppoſing* 10 *in the morning.*
4. *His right and oblique aſcenſion.*
5. *His aſcenſional difference.*

6. *His*

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now) it is a ridiculous whim; for *Sirius* does not now riſe *heliacally* till near *September*, though our almanack-makers (for what reaſon I know not) continue the beginning of *Dog Days*, *July* the 30th. But, however, it is plain that *Sirius* can no ways be charged with bringing this ſultry weather; becauſe 3 or 4 thouſand years hence he will not riſe *heliacally* till *November*, and then, perhaps, will be charged with bringing as much cold, by the ſame rule.

RULE.

To find the *heliacal* riſing, or ſetting, the rule is, rectify the globe, and bring the given ſtar to the eaſtern verge of the *Horizon*; then fix the globe, and turn the quadrant to the weſtern ſide, till 12° of the quadrant touches the ecliptic; this done, note the degree of the ecliptic, that is cut by 12° of the quadrant on the weſtern ſide (for then will the real place of the ſun be depreſſed 12° on the eaſtern ſide) for that degree ſought in the calender gives the *heliacal* riſing. The ſame is to be obſerved with the quadrant on the eaſtern ſide for the *heliacal* ſetting. Thus you will find *Aldebaran* riſes *heliacally*, *July* the 4th, ſets *heliacally*, *May* the 5th.

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And now, *Tyro*, I will leave you one queſtion for practice at your leiſure, in order to exerciſe you in the foregoing *Problems*.

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PROB. LXIV.

The latitude and day given (ſuppoſe at London, November *the 5th) to tell,*

1. THE *riſing and ſetting of the ſun, and the point he riſes and ſets upon.*
2. *His meridian altitude.*
3. *His altitude at any hour, ſuppoſing* 10 *in the morning.*
4. *His right and oblique aſcenſion.*
5. *His aſcenſional difference.*

6. *His*

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now) it is a ridiculous whim; for *Sirius* does not now riſe *heliacally* till near *September*, though our almanack-makers (for what reaſon I know not) continue the beginning of *Dog Days*, *July* the 30th. But, however, it is plain that *Sirius* can no ways be charged with bringing this ſultry weather; becauſe 3 or 4 thouſand years hence he will not riſe *heliacally* till *November*, and then, perhaps, will be charged with bringing as much cold, by the ſame rule.

6. *His amplitude at riſing.*
7. *His* Azimuth *at* 10 *in the morning.*
8. *His almicanter the ſame time.*
9. *The time is due E.*
10. *The length of day and night.*
11. *The length of twilight.*
12. *The length of the real night.*
13. *The inhabitants to whom he will be vertical that day.*
14. *The very place to which he will be vertical at* 10 *o'clock at night, at* London. *Alſo,*
15. *To tell what time* Aldebaran, *or any ſtar, will riſe and ſet that night.*
16. *To tell alſo what time any ſtar will be due E. or W. (ſuppoſe* Aldebaran) *what is its amplitude at riſing and ſetting, its* Azimuth *at* 8 *at night, and the time of being full S. Alſo,*
17. *To tell what point of the compaſs the pointers will then be on, and what time they will be on the meridian above, and under the pole ſtar.*

Tyro. You may depend, Sir, upon my trying to work this *Problem* the firſt opportunity.

Philo. Very well; ſince you delight in theſe things, I will not leave you yet, but will ſhew you ſome *Problems* relating to navigation and ſpiritual triangles, *&c.* Here follows,

SECT II.

Containing ſome more uſeful Problems *in navigation.*

PROB. I.

The ſun's declination and hour, when he is due E. given, to find the latitude, viz. *the elevation of the pole.*

RULE.

RECTIFY the globe to the ſame latitude as the given number of degrees of declination, and fix the quadrant in the *Zenith*; then convert the hours that the ſun is due E. before, or after, 6 o'clock, into degrees, and count the ſame number of degrees on the *Horizon* from the E. point ſouthwards, and bring the quadrant to that degree of the *Horizon*, ſo ſhall the degree on the quadrant that is cut by the *Equator* be the complement of latitude, which taken from 90°, gives the latitude itſelf, or height of the pole.

EXAMPLE.

Sailing *May* the 21ſt, I made an obſervation that the ſun was due E. about 7 m. paſt 7 in the morning, and his declination 20′ N. I demand what latitude I was in?

Proceed by the rule, you will find the latitude to be 51½ d. nearly.

PROB. II.

Having the ſun's Azimuth *at* 6 *o'clock, and declination, to find the latitude.*

RULE.

AS many degrees as are contained in the *Azimuth* given, ſo much elevate the pole, and fix the quadrant in the *Zenith*, and bring ♈ to the meridian: this done, count on the quadrant upwards, the complement of the ſun's declination to 90, and bring that degree to the *Equator*, then the degree of the *Horizon*, cut by the quadrant, ſhall be the complement of latitude, counted from the S. point, or elſe from the N. as it may happen, and the remainder to 90 is the latitude required; or otherwiſe, the degrees counted from the other two cardinal points, either E. or W. as it may happen, will give the latitude.

EXAMPLE.

I find the ſun's *Azimuth*, at 6 o'clock, to be 12 d. 15 m. and his declination 20 d. 10 m. what is the latitude? Work according to the rule, you will have the anſwer 38 ½ d. complement, that is 51 ½ d. latitude required.

PROB.

PROB. III.

The ſun's amplitude and aſcenſional difference given, to find the elevation of the pole and ſun's declination.

RULE.

RAISE, or elevate, the pole ſo many degrees as is the aſcenſional difference, and fix the quadrant in the *Zenith*, and bring ♈ to the meridian, then count on the quadrant upwards the complement of altitude, and move the quadrant, till the ſame number on the quadrant cuts the *Equator*; and the quadrant will cut the *Horizon* in the degree of the pole's elevation, and the *Equator* in the degree of declination.

EXAMPLE.

I made an obſervation, that the ſun's aſcenſional difference was 27 d. 20 m. and his amplitude 33 d. 24 m. I demand the latitude and declination?

Proceed according to the rule, and you will find the latitude 51 ° 30 ′, and the declination 23 ° 10 ′.

PROB. IV.

The ſun's altitude E. and his declination given, to prove the elevation of the pole.

RULE.

ELEVATE the pole to the complement of the ſun's altitude at E. and fix the quadrant in the *Zenith*, and bring ♈ to the *Meridian*, then number on the quadrant of altitude the degree of declination, and bringing the ſame to the *Equator*, obſerve what degree the quadrant cuts the *Equator* in; for its complement to 90 d. is the heighth of the pole.

EXAMPLE.

The ſun's declination is 20 ° 10′ N. his altitude at E. (at *London)* is nearly 26 d.

I would

I would know whether the ſuppoſed latitude (51 ½) agrees herewith in operation?

Here I ſubtract 26 from 90 d. and there remains 64 d. complement of altitude, and I elevate the pole accordingly, *&c.* Then I bring ♈ to the *Meridian*, and cauſe 20° 10′ on the quadrant to cut the *Equator*, and find it nearly 38 ½ d. the complement of latitude required; which ſubtracted from 90, gives 51 ½ d. the real latitude of the place.

* * *

PROB. V.

The ſun's declination and amplitude given, to find the heighth of the pole.

RULE.

ELEVATE the pole to the complement of amplitude, and fix the quadrant in the *Zenith*, and bring ♈ to the *Meridian*, then count the ſun's declination on the quadrant, and bring that degree to the *Equator*; and the degree of the *Equator*, cut by the quadrant, is the latitude required.

EXAMPLE.

Suppoſe the ſun's amplitude 33° 20′, his declination 20° 10′, what's the latitude?

Proceed according to the rule, you will find it about 51° 30′.

Tyro. I heartily thank you, Sir.

Philo. There are many other queſtions relating to navigation, which may be deduced from theſe, and performed on the globes; which you will find treated of by and by.

SECT. III.

Contains ſome practical Problems, relating to ſpherical triangles, applied in ſome meaſure to navigation, dialling, &c. *by which the learner will ſee more of the nature of the doctrine of the ſphere, than he poſſibly can by way of plane.*

Note 1. That every triangle has 3 ſides and 3 angles.

2. The *Perpendicular* (called alſo *Cathetus)* ſhall be here repreſented by, or placed on, the *Brazen Meridian* itſelf.

3. The baſe ſhall be placed in general upon the *Equator.*

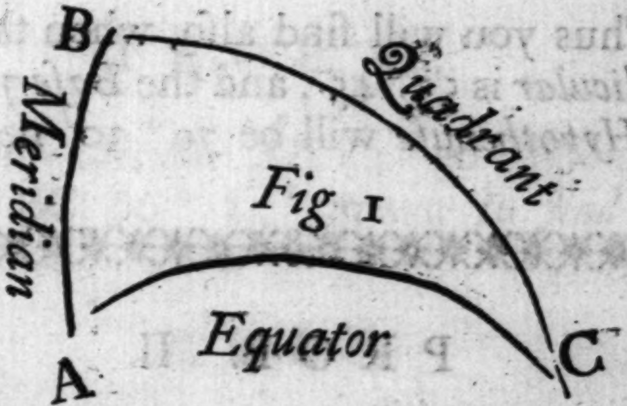
4. The *Hypothenuſe* (or diagonal line) is repreſented by the quadrant fixed to the *Zenith*, and turned to the extremities of the *Perpendicular* and *Baſe*, which will form a compleat right angled triangle.

5. A right angled triangle is ſuch as has one of the angles right, or that contains 90 d. An acute angle is leſs than 90 d. and an obtuſe angle is more than 90 d. as you will ſee by *Prob.* V.

PROB.

PROB. I.

In the right angled ſpherical triangle ABC, *let the perpendicular* AB *be* 42° 30′, *the baſe* AC 60° 15′. *I demand the Hypothenuſe* BC?



BRING ♈ to the *Brazen Meridian*, and there faſten the globe; then count from *Aries* 42° 30′ on the *Brazen Meridian*, which is the perpendicular, and at 42° 30′ fix the quadrant of altitude. Then count from *Aries* on the *Equator* 60° 15′, which ſhall repreſent the *Baſe*; and note well the degree on the *Equator*, or elſe make a ſmall dot. This done, turn the quadrant till the figured edge of it touches the *Equator* at 60° 15′; and the degrees on the quadrant from the *Equator* to the *Zenith* ſhall be the *Hypothenuſe* required, *viz.* about 68° 15′.

Note. It matters not in theſe ſort of *Problems* whether you elevate the pole to the number of degrees of the perpendicular; for the anſwer will be the ſame if you do, or do not.

Thus you will find alſo, when the *Perpendicular* is 55° 45′, and the *Baſe* 70° 30′, the *Hypothenuſe* will be 79° 30′ nearly.

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PROB. II.

The Baſe AC 60° 15′ *and Hypothenuſe* BC 68° 15′ *given, to find the Perpendicular* AB.

RULE.

COUNT from *Aries* on the *Equator* the baſe AC, and let the quadrant be on the *Meridian*, without being fixed faſt, ſo that you may ſlip it backward and forward, till 68° 15′ of it (which is the *Hypothenuſe*

pothenuſe BC) juſt touches 60° 15′ on the *Equator*; for then will the *Meridian* from *Aries* to the nut of the quadrant tell you the perpendicular AB; *viz.* 42° 30′. *See the figure.*

* * *

PROB. III.

The perpendicular AB 42° 30′ *Hypothenuſe* BC 60° 15′ *given, to find the baſe* AC.

RULE.

COUNT from *Aries* on the *Meridian* 42° 30′ the *Perpendicular* AB, and there fix the quadrant; then turn the quadrant till 68° 15′ on the quadrant from the *Zenith*, touches the *Equator*, and the degrees on the *Equator* intercepted between the point *Aries*, and the quadrant, ſhews you the baſe AC; *viz.* 60° 15′. *See the figure.*

Tyro. I underſtand the operations quite well.

Philo. I am glad of it; and this pleaſes me much to ſee you can apply things ſo well: for as you obſerve the *Horizon* cuts the meridian at right angles, as well as the *Equator*; therefore, by counting the *Perpendicular* from the *Horizon* on the meridian, the quadrant will ſtill be the *Hypothenuſe*, and will cut the *Horizon* at the contents, or degree, of the *Baſe*, as it did the *Equator* before.

From hence ariſe the following obſervations.

OBSERVATION I.

The N. and S. part of the *Brazen Meridian* being 180° diſtant, it is plain that the quadrant of altitude fixed in the *Zenith* will (however extended) make 2 angles equal to 180°, or half the circle. For inſtance, if I lay the quadrant from the *Zenith* to the E. or W. points, I then have 2 right angles, each equal to 90°, *viz.* 180; and if I move the quadrant from theſe points, ſuppoſe 30°, to the N. or the S. I ſtill have 2 angles made by the quadrant, the *Meridian* and *Horizon* equal to 180°; *viz.* one of them equal to 120°, and the other equal to 60°.

OBSERVATION II.

From hence then it very plainly appears, that you may (by a little conſideration) know the meaſure of any ſide, or the angle forming any 2 ſides of a triangle; *viz.* whether it be an *acute* angle (*viz.* leſs than 90°) or an *obtuſe* angle (*viz.* more than 90°; for all the 3 angles together are always equal to 2 right angles; *viz.* 180°, as in the laſt obſervation.

Tyro. I am ſtill more highly obliged to you, Sir, for this clear demonſtration.

Philo. I ſhall then leave it wholly to your conſideration and practice, as it is ſo natural in itſelf, and proceed to an uſeful application of *Prob.* I.

PROB. IV.

A ſhip ſails from the N. latitude 55 *d.* 45 *m. in a direct courſe, till ſhe comes to the* Equator, *and her difference of longitude is* 76 *d.* 30 *m. E. from the place where ſhe departed: I demand the rhumb in navigation ſhe is then upon, and the diſtance from the place ſhe ſailed from, allowing* 60 *miles to a degree, and her diſtance in an arch of a great circle,* viz. 69 ½ *miles to a degree?*

Note. See the operation at the end of *Problem* I. which is 79 ½ d. nearly; allowing then 60 to a degree, it is 4770 miles; but at 69 ½ to a degree, it is 5525 miles 1 quarter.

PROB.

PROB. V.

Two ſhips, B *and* C, *are in the latitude* 51½ d. N. *and in* 18° *W. from* London, *from which place they ſet ſail*; B *goes S. W. by W.* 51° 30′, *and* C *ſails* E. S. E. 30° 3′. *I demand,*

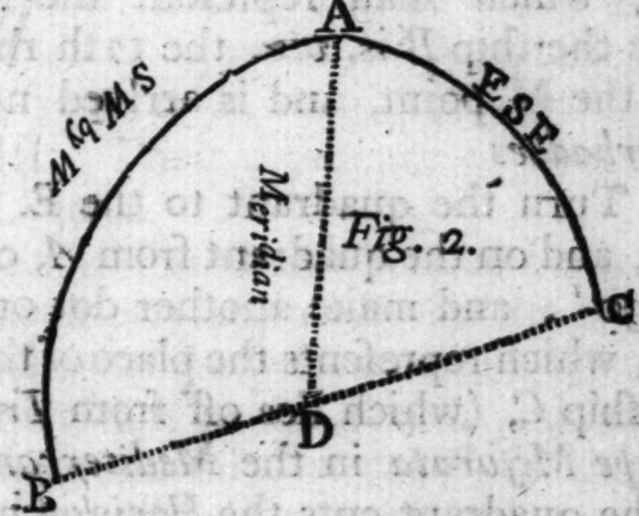


Fig. 2.

1. *The rhumb (from the* N.*) each ſhip ſailed upon.*
2. *The angle they make at ſetting out.*
3. *Their difference of longitude from the place they ſet out at.*

4. *Their diſtance and ſituation from each other. And*
5. *The places they arrive at.*

1. THE globe rectified, and ♈ brought to the meridian, turn the quadrant from *A* the *Zenith*, till it cuts the S. W. by W. point, and at 51 ° 30′ from *A* upon the quadrant, make a dot on the globe, which ſhall repreſent the place where the ſhip *B* is, *viz.* the 11th rhumb from the N. point, and is arrived nearly at *Barbadoes*.

2. Turn the quadrant to the E. S. E. point, and on the quadrant from *A*, count 30 ° 30 ′, and make another dot on the globe, which repreſents the place of the ſecond ſhip *C*, (which lies off from *Tripoly* by *Cape Meſurata* in the *Mediterranean)* and the quadrant cuts the *Horizon* in the 10th rhumb from the N. point.

3. Obſerve what angle the quadrant cuts the *Horizon* in, counted from the S. point, or meridian, *A D* itſelf, and you will find that *B A D* is 56 ° 15 ′, and *D A C (viz. D C)* is 63° 30′, the an-

gle the ſecond ſhip makes with the meridain at A.

5. Add theſe 2 angles together, ſhews the whole angle that *A* makes with the *Horizon*; *viz. BCD* 123° 45′.

5. Bring the place each ſhip is in to the meridian ſeparately, it will ſhew you the difference of their meridian from the firſt ſetting out; *viz.* their difference of longitude: that *B* will be found to have made 41 d. 15 m. of W. longitude, and *C* 34 d. 15 m. of E. longitude from the place at firſt. Their difference of longitude is 75 d. 30 m.

Laſtly, For their diſtance, bring either of the ſhips (ſuppoſe *B*) to the meridian, and elevate the pole accordingly, and fix the quadrant in the *Zenith*, and extend it to the ſecond ſhip, or dot *C*, on the globe, and you will find it about 70 d. 14m. N. E. by E. of *B*. the diſtance required; which multiplied by 60, gives 4245 milcs, and by 69 ½, gives 4917 miles nearly.

Tyro. I could not have thought the uſe of that little appendant, the quadrant, had been ſo extenſive; for, I perceive plainly that when the quadrant is fixed in the

Zenith, it always makes 2 angles, both of which muſt of courſe be 180 d. Thus, if I turn it right to the E. point, I have two angles, called right angles, each of which is 90 d. *viz.* 280 d. If I turn it any where elſe at pleaſure, ſuppoſe on the E. N. E. point, I then have two angles; *viz.* the *Zenith* from the N. point itſelf, to the E. N. E. point, which is 67 d. 30 m. called an *acute angle*, or leſs than 90 d. and the other angle from the S. point, to E. N. E. is 112 d. 30 m. which is 22 d. 30 m. more than 90 d. or a *right angle*, and is called an *obtuſe angle*.

Philo. I am glad to ſee you can turn what I have ſhewn you into ſo good an application. I ſhall, therefore, ſhew you how to make a common dial, from whence you will naturally ſee the nature of the ſphere more plainly, and by the interſection of the different circles, will be able to raiſe many curious and uſeful *Problems*.

PROB.

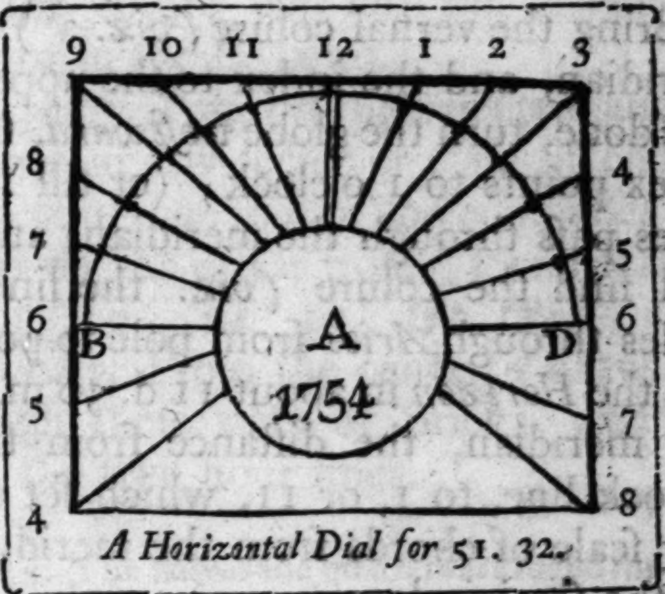
PROB. VI.

To make an horizontal dial (viz. *a dial to be ſet upon a poſt, or pedeſtal) in any latitude; but ſuppoſe for* London.

EXAMPLE.

LET it be required to make an horizontal dial for the latitude of *London.*

Firſt, Take a piece of braſs, or a thick ſmooth painted piece of board, the ſize you intend your dial for; and deſcribe a ſemicircle at pleaſure from the center *A.*



A Horizontal Dial for 51. 32.

Secondly, Divide this ſemicircle into 2 equal parts by the line *A* 12.

Thirdly, Draw the lines by the extremity of the circle to contain the hour lines; and thus is your plane, or dial, ready to have the hours drawn from the center.

Now to find the diſtance from the meridian, or 12 o'clock line, in degrees or minutes.

RULE I. is,

Bring the vernal colure (*viz.* ♈) to the meridian, and the index to the upper 12; this done, turn the globe *weſtward*, till the index points to 1 o'clock; (or till 15 degrees paſs through the meridian) and you will find the colure (*viz.* the line that paſſes through *Aries* from pole to pole) to cut the *Horizon* in about 11 d. 50 m. from the meridian, the diſtance from the 12 o'clock line, to 1, or 11, which ſet off by any ſcale of chords from the meridian 12 on the ſemicircle.

Secondly, Turn the globe till the index points to 2, and the colure will cut the *Horizon* in 24 d. 15 m. the diſtance from 12 to 2 or 10: turn the globe till the index points to 3, the colure will cut the *Horizon* from the *Meridian* in about 38°, 10′ the diſtance from the *Meridian* to 3 or 9: turn it till the index points to 4, and the colure will cut the *Horizon* 53° 36′ in the diſtance from 12 to 4 or 8. Turn it till the index points to 5, and the colure will cut the *Horizon* in better than 71°, the diſtance from the *Meridian*, or 12 o'clock line, to 5 or to 7. The 6 o'clock line will be 90°, or fall in the line *C D*; viz. the colure will cut the *Horizon* at 90°, or in the *E.* point.

Secondly, Take off theſe degrees and minutes from any ſector or ſcale of chords; and ſetting one foot of the compaſſes in *C*, ſet off on the circle from *C* towards *B* and *D*, 11° 50′, 24° 15′, *&c. &c.*

Thirdly, From the center *A* draw lines through theſe dots or pricks, and you have the true hour lines.

Note 1. The halves and quarters are found the ſame, by turning the globe till the index points to ½ paſt 12; ½ paſt 1, *&c.* and obſerving in how many degrees the colure cuts the *Horizon* from the *Meridian*.

Note 2. After you have drawn the hours from 12 to 6 in the morning, and 6 in the evening, you may eaſily get the hours at 5 and 4 in the morning, by laying a ruler from the hours of 5 and 4 in the afternoon, and drawing lines through the center. The ſame on the other ſide of the plane, drawn from 7 and 8 in the morning, will be 7 and 8 at night.

Note 3. The ſtyle or gnomon of this dial makes an angle with the 12 o'clock hour line of 51 d. 32 m. and muſt be put in at the centre *A*, and ſtand right up over the 12 o'clock line, or meridian of the plane.

☞ *Note.* Always remember to make an allowance for the thickneſs of the ſtyle or gnomon on the plane, by drawing two lines by the ſide of the *Meridian* line, as wide as the ſtyle is thick.

PROB.

PROB. VII.

To make a direct S. dial in the latitude of London.

There are two ways.

FIRST, let the globe remain for the latitude of *London* as before, and fix the quadrant in the *Zenith*, and turn it to the E. point, and there fix it (or to the W.) then turn the globe to 11 o'clock or to 1, and the colure will cut the quadrant in 90° 30′.

Turn it to 10 or 2, the colure will cut the quadrant in 19 d. 32 m. the diſtance from the *Meridian.*

Turn it to 9 or 3, it cuts the quadrant in 32 d. 10 m.

Turn it to 8 and 4, it cuts it in 48 d. 5 m.

Turn it to 7 and 5, it cuts it in 67 d.

Or,

2. Elevate the pole to the complement of *London*'s latitude to 90 (*viz.* for 38½ and

51 ½ make 90) then turn the globe till the index points to 11 or 1, and the colure will cut the *Horizon* in 9 d. 30 m. turn it to 10 or 2, the colure will cut the *Horizon* in 19 d. 32 m. *&c.* as before.

Tyro. Sir, I am extremely obliged to you, but if it were not too much trouble, I would deſire you to give me one example how to make a vertical dial that declines from the S. either eaſt or weſtwards; for you know that it is a chance indeed that a wall ſhould exactly face the ſouth.

Philo. I am ready to do every thing, *Tyro*, that lies within the compaſs of time, room, and ability. We will ſuppoſe then it were required as follows; *viz.*

PROB.

PROB. VIII.

To make an erect, or vertical dial, declining from the North towards the Eaſt or Weſt.

EXAMPLE.

Let it be a dial declining from the N. eaſtward 60 *d.*

RULE.

1. RECTIFY the globe, quadrant, colure, and index, as before.

2. Bring the quadrant of altitude to cut the *Horizon* in the degree of declination; *viz.* 60 d. from the N. point, either eaſtward or weſtward, which repreſents a plane, declining that number of degrees.

3. Hold the quadrant faſt at 60 d. and turn the globe eaſtward, till the index points to all the forenoon hours, and the colure will cut the quadrant on the number of degrees each hour is diſtant from the *Meridian*; and lines drawn through

each of theſe from the center, are the hours required.

Thus to find the forenoon hours,

I turn the globe till the index points to 11, 10, 9, *&c.* or till 15 d. of the *Equator* paſs through the *Meridian*, and I find the colure cuts the quadrant (from the *Zenith)* as follows,

		d.	m.
11	o'clock	9	30
10	———	18	15
9	———	26	12
8	———	35	5
7	———	45	10
6	———	57	20
5	———	76	00

The forenoon hours required, which will be on the W. or left-hand ſide of the 12 o'clock line, becauſe the plane declines eaſtward, and conſequently you have more hours in the forenoon, than in the afternoon, on this plane.

2. *To*

2 *To find the afternoon hours.*

I now turn the quadrant to the oppoſite point of the *Horizon*; *viz.* I cauſe it to touch 60 d. of the *Horizon* from the S. towards the W. and bring the index and colure back to the *Meridian.*

Then turning the globe weſtward till the index points to 1, 2, 3, and 4, or till 15 d. paſs through the *Meridian*, and the colure will cut the quadrant (counted from the *Zenith)* as follows,

For	1	o'clock	12	45
	2	———	29	45
	3	———	52	45
	4	———	80	15

Theſe are the diſtances of the afternoon hours, from the 12 o'clock hour or *Meridian.* Here you ſee the colure goes off the quadrant; therefore the ſun goes off this plane about 4.

3. *To find the diſtance of the ſubſtyle or place of the gnomon from the* 12 *o'clock line*; *as alſo the heighth of the ſtile, do thus :*

Bring the colure to the *Horizon* in the plane's declination counted from the S. towards the E. *viz.* bring the colure to 60 d. in the *Horizon*, counted from the S. eaſtward; and then turn the quadrant till *that* touches the ſame number of degrees (*viz.* 60 d.) from the N. eaſtward; ſo ſhall the quadrant and colure cut each other at right angles; and the number of degrees counted on the quadrant from the colure to the *Zenith* are the degrees of the ſubſtyle's diſtance, *viz.* 21° 40′; and the degrees from the pole to where the quadrant cuts the colure, counted on the colure, is the heighth of the ſtyle, *viz.* 32° 45′.

Laſtly, Meaſure or take off 21° 40′ from any ſcale of chords, and ſetting one foot at the 12 o'clock line, turn the other weſtward, or to the left-hand, and make a dot or prick, for right over this dot muſt the ſubſtyle or gnomon ſtand.

And thus by a little conſideration may any ſort of *declining*, *inclining*, or *reclining* dials be eaſily made by the globe. For a direct S. dial at *London* will be an *Horizontal* dial to the inhabitants of 38° 28′ S. latitude; *viz.* 90 d. diſtance from our *Zenith*.

So an *erect* plane under the pole is an *Horizontal* under the *Equator*. An *erect vertical* at 80 d. N. latitude, will be a *Horizontal* in 10 d. S. latitude, *&c.* *&c.*

Tyro. Sir, I heartily thank you; for this gives me a greater notion of the poſition of places and planes than I had before. But pray may not ſome *Problems* relating to the moon be performed by the globes?

Philo. Yes; the very ſame as the ſun, when once you know her place in the ecliptic; but this you muſt do very often, becauſe of her place according to her mean motion; but this ſo very quick and variable that the operation will not ſtand long, or hold good, but for that day only; but by getting her true place, you may tell her riſing, ſetting, and ſouthing the hour of the night, the time of high water, *&c.* *&c.*

I will

I will give you a ſmall notion of it, and leave the reſt for your curioſity. Divide the equinoctial into 30 parts (*viz.* at every 12th degree) by red ſtrokes or figures, marking it from *Aries* at every 12th degree, 1, 2, 3, 4, *&c.* this repreſents the 30 days of her age.

Now to find her place. Elevate the N. pole in the *Zenith*, and bring the equinoctial colure againſt the day of the month in the *Horizon*, ſo ſhall the moon's age (wrote in red figures) on the equinoctial, point to the degree ſhe is in at that time.

Tyro. I am extremely obliged to you, Sir, for all theſe favours; but, as neceſſity obliges me to go, I beg you would excuſe me, and receive my hearty thanks.

Philo. My dear pupil, I wiſh you well, and would recommend to you the practice of theſe things at a ſuitable opportunity, rather than ſpending your time in trifles and idleneſs.

Tyro. Sir, I thank you for your good advice, and am your humble ſervant.

Philo. Farewel.

POSTSCRIPT.

Here follows an accouut of the Patent Globes, which are mounted by the Patentee, Mr JOHN NEALE, at his houſe in Leadenhall-ſtreet, London.

THE terreſtrial globe is mounted with the *Horizon* fixed vertical, and the globe placed to move therein upon its own axis, thereby to repreſent its diurnal motion; beſides which, it alſo moves upon the axis of the ecliptic, to demonſtrate all the mutation of the ſeaſons, from its annual motion. At a diſtance from the globe is a ball, to repreſent the ſun, which remains fixed; and from the N. pole ſome wheel-work is placed, to convey a motion to the moon, which moves round the globe; and between it and the ſun, in 29½ days, from one conjunction to another, but round the earth itſelf in leſs than 27½ days; through the center of the ſun runs a piece of ſteel, called a pointer, to take in and out at pleaſure, which repreſents a direct ray from the ſun, and (by means of ſome wheel-work at the S. pole) ſhews all thoſe countries to which the ſun, at any particular time, is vertical, and if obſerved ſix months ſucceſſively, or while the ſun is paſſing from one equinoctial point to the other, or from tropic to tropic, will afford a pretty appearance. Suppoſe, for inſtance, the ſun to be in the northern tropic, or that of *Cancer*, by that pointer will be ſhewn, as the globe is turned about, that a vertical ray repreſents a ſpiral line round the earth, from the tropic of *Cancer* to that of *Capricorn*, and then back again from *Capricorn* to *Cancer*, each line every day at noon falling at the diſtance of about ſeven minutes from that of the preceding day; which being ſo clearly demonſtrated by this method of mounting, that any perſon may have a very juſt idea of the true cauſe of all the variations of the ſeaſons, even from this particular; for from hence a youth will be naturally led to examine why this phænomenon happens; when, upon a diligent obſervation, he will ſoon perceive that it ſprings from the N. pole, receding more and more from the ſun, by the earth's advancing in its annual circuit. Thus, let us now ſuppoſe it to be *June* the 21ſt *N. S.* the pointer then falls directly on the tropic of *Cancer*; when it will be obſerved, that all the countries on the N. ſide of the *Equator* have their days at the greateſt length, and that this length encreaſes with their diſtance from the *Equator*. Hence alſo the youth will perceive the natural cauſe of its being all day and no night, to all the inhabitants within the *Artic* circle, whilſt the reverſe of this happens to thoſe who people the *Antartic*; and, as he turns the globe about, to obſerve his pointer approaching the *Equator*, he will be no leſs agreeably entertained by viewing as many degrees within the *Artic* circle roll below the *Horizon*, as his pointer has receded from the aforementioned tropic, till it arrives at the equinoctial line, when it will appear ſelf-evident why the days and nights are then equal all the world over, by noting the S. pole, which before never appeared above the *Horizon*, now ſhews itſelf even with it, while, at the ſame time, the northern one, which was much elevated above it, is now upon a level therewith, and that the *Horizon* and circle, which is the boundary of light and darkneſs, and which before cut the parallels of latitude or declination unequally, now biſects the ſame, and cauſes an equal diſtribution of day and night throughout the whole *Terrene*. If from henceforward the youth continues the rotation of the globe, he will obſerve, that as many degrees as the ſame pointer advances on the S. of the *Equator*, juſt ſo many degrees will the N. pole deſcend below the *Horizon*, till it arrives at the tropic of *Capricorn*, when the extremity only of the *Atic* circle will appear even, or upon a level therewith; and, conſequently, all thoſe countries between that circle and the pole, will then begin to loſe ſight of the ſun's body;

and, whilſt the inhabitants of the ſouthern pole enjoy an uninterrupted day, thoſe in the northern one are ſunk in obſcurity and twilight.

I have ſaid before, that on the terreſtrial globe of this new improvement, the moon moves between the earth and ſun; I ſhall now add, that at the diſtance of a quadrant of a circle from the moon, is placed another circle, which being fixt on the center of the moon's motion, always moves round with her, thereby ſhewing throughout her courſe, all thoſe countries in the northern hemiſphere to which ſhe is at any particular time riſing, thoſe where ſhe is then ſetting, and thoſe to whom ſhe is then due S. as alſo, the exact difference of time between the riſing and ſetting of the ſun and moon, all which will be further enlarged on, when I come to ſhew the method of ſolving the *Problems* relating thereto. After I have ſpoken a little relating to the cœleſtial globe, which is mounted not quite ſo different from the common globes, as that I have been ſpeaking of.

The *Horizon* in this is as uſual, and the globe moveable to the latitude of any country, only inſtead of thoſe upright pillars to ſupport the *Horizon* as common, here ſemi-circles are fixed on the pedeſtal, and from the pole of the *Equator* a motion is conveyed to the pole of the ecliptic, where two arms, or indexes, are placed, on which the artificial ſun and moon are poſited (much after the nature of that excellent contrivance communicated to the *Royal Society*, in the year 1747, by the ingenious Mr. *Ferguſon*) theſe, as the globe is turned about, keep their exact motions over the ſame, ſimilar to, and in like manner as thoſe two luminaries do in the heavens; ſo that once being ſet right by an ephemeris, they will remain ſo, and thereby ſhew the riſing and ſetting of theſe luminaries, with the length of the day and night; together with the true cauſe of all the viciſſitudes of the ſeaſons; and though they have a motion ſeemingly from E. to W. yet do they really move from W. to E. the moon in very little more than 29½ days, and the ſun in a year. For inſtance, ſuppoſe it now to be the 10th of *March*, the ſun entering *Aries*, and the moon in conjunction with him, if I turn about the globe with the key, I ſhall obſerve when the moon has got round the point *Aries*, from whence ſhe firſt ſet out, which will be in little more than 27 days (which is called her periodical month;) that, notwithſtanding, ſhe has made an entire revolution round the earth, yet will ſhe not be got in conjunction with the ſun; becauſe, that during the time ſhe is performing this her periodical revolution, as a ſecondary round the earth, that primary, and of courſe the moon itſelf, its ſattelite, has advanced almoſt a whole ſign, or thirty degrees *in conſequentia*, or according to the order of the ſigns in the *Zodiac*; ſo that, *that* point in her orbit, in which ſhe was, when in conjunction with the ſun at her firſt departure, will be now ſo far to the weſtward, as to take her up two days, five hours, one minute, three ſeconds, before ſhe comes in conjunction with him again, or has compleatly exhibited all her phaſes. Hence the globe muſt be turned more than twice about again, before the moon can overtake him, which at once affords a very clear idea of the difference between the periodical and ſynodical month.

Here alſo may be obſerved, that the ſun's coming above the *Horizon* is very different with reſpect of time, he riſes much ſooner, and ſets much later; and, therefore, the days of courſe are longer, and nights ſhorter, in the northern hemiſphere; and that with regard to place, he likewiſe riſes and ſets in a different part of the *Horizon*, which difference is called the difference of his amplitude, now riſing N. E. and ſetting N. W. whereas before he roſe due E. and ſet due W. and, if the globe be ſet to any latitude, within the artic circle, the ſun and moon will then move round, without deſcending below the *Horizon*, at certain times, from whence you will naturally diſcern the reaſons why theſe variations thus happen.

I cannot here omit taking notice, how beautifully this method of exhibiting the heavenly appearances repreſent thoſe luminaries we have been ſpeaking of in their apparent motions to the inhabitants of the polar circles. For inſtance, if the globe be rectified to the latitude of any country within the artic circle, by only turning the globe about with the winch, you will obſerve, how many days the ſun ſhines upon them without ſetting, and how many days he is totally abſent; as in the former caſe, the ſun will continue above the *Horizon* for ſeveral revolutions of the globe, ſo in the latter, he will not make his appearance above it for ſome conſiderable time. From whence it will be naturally demonſtrated, how impoſſible it is for the inhabitants of that place to have any ſight of a new moon, during the ſun's continuance below the *Horizon*, any more than they will be able to diſcern a full moon, while the ſun is above their *Horizon*.

Again, From the ſtem on which the ſun is fixed, two little balls (repreſenting *Mercury* and *Venus*) are ſo contrived, as to take on and off at pleaſure: and as their ſtems are made with joints, they may be placed at any number of degrees diſtant from the ſun, anſwering to their true place in the heavens at any given time; by which their appearing alternately as morning and evening ſtars, and every *phænomena* that happens to them may be very readily exhibited: but then theſe can't (with convenience) be placed upon the globes leſs than 12 inches diameter, they being too ſmall to admit of them.

And thus by the mounting, or adding, ſuch appendant to the common globes, the moſt ignorant perſon may ſee at once (as it were) the beauty, and harmony, and order of the ſun, and the inferior planets belonging to, and revolving round him as their common center, according to the preſent ſyſtem of aſtronomy.

N. B. Globes thus mounted, are at preſent but of two ſizes, *viz.* thoſe of 3 and 12 inches diameter, which are to be had of the *Patentee*, at his houſe in *Leadenhall-Street*, *London*, as aforeſaid.

The price of the 12 inch globes mounted in a beautiful manner with the aforeſaid apparatus, is 16 guineas, and the price of thoſe 3 inches diameter, is 6 guineas.

FINIS.

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